Aspects of economy and environment of north west Lewis in the first millennium AD: the non-marine faunal evidence from Bostadh and Beirgh considered within the framework of north Atlantic Scotland.

Jennifer E. Thoms

Thesis submitted for the degree of PhD

Department of Archaeology
University of Edinburgh

2003

Declaration

This is to certify that this thesis has been composed by the author and that the work is the author's own. It has not been submitted for any other degree or qualification.

Jennifer E. Thoms

Abstract

The non-marine faunal remains from excavations at the sites of Bostadh Beach, Great Bernera and Loch na Beirgh, Bhaltos, Lewis were analysed to investigate aspects of the economy and environment in the first millennium AD. Both sites show structural evidence of occupancy over several hundred years, covering several structural phases with evidence of rebuilding and repairs to buildings. At the site of Bostadh the occupation phases appear to encompass the cultural change involved in the arrival of the Norse, allowing changes in economic strategies between the two cultures to be examined. The bones from four occupation phases at Bostadh were analysed, and from one occupation phase at Beirgh. The evidence from these two sites was considered in the light of work previously carried out in the Bhaltos peninsula, Lewis, and in similar studies elsewhere in north Atlantic Scotland.

The general condition of the bones was good, reflecting the calcium rich machair soils of the area, and making them an important resource in the understanding of the economy and environment of Atlantic Scotland in the first millennia AD. The state of preservation and fragmentation of each of the bone specimens was recorded with the hope of furthering understanding of site formation processes. The good condition of the bones made them highly identifiable and of considerable archaeological value.

A range of mammalian and avian species were retrieved from both sites indicating a mixed economy with opportunistic use made of locally available resources. The bones of red deer (*Cervus elaphus*) are particularly abundant within the assemblage of bones retrieved from both sites, suggesting a heavy reliance on the animals for meat. The apparent importance of red deer in the economy of these sites is unusual in north Atlantic Scotland and some consideration is therefore given as to how the animals were procured and whether some sort of management of the herds may have been taking place. Changes in the exploitation of animals over time are noted at Bostadh. Cattle and caprine (sheep or goat) bones are also present in substantial quantities. Other species represented in the assemblages include pig, otter, and dog, grey and common seal and a range of seabird species.

ACKNOWLEDGEMENTS

I am grateful for funding received from Historic Scotland for both fees and maintenance during the first three years of this research. I received money from the Lewis Stewart Memorial Fund, the Abercromby Fund, C.F.A and the University of Edinburgh Small Projects Fund that enabled me to attend an international zooarchaeological conference in Victoria, British Columbia, Canada. The conference was particularly rewarding and allowed me to establish fruitful contacts with other zooarchaeologists, which have proved invaluable throughout the time I have been researching this study.

I am indebted to Dennis Harding and Tim Neighbour for allowing me to work with the material from their excavations.

Professor Ian Ralston supervised the second half of this research and I am very grateful for his considerable knowledge, guidance, advice and encouragement and for his unstinting help and great patience. In addition, I received helpful comments on a very early draft of my research design from Ian, long before his official involvement in my research, which were exceptionally useful and encouraging, and for which I would like to thank him in particular.

Professor Dennis Harding also supervised the second half of the research and I am grateful for interesting conversation, advice, guidance and encouragement, which always reignited enthusiasm for the subject. Dr Nicola Murray and Dr Bill Finlayson supervised the first two years of my research and provided administrative assistance. Dr James Barratt gave advice and guidance in the middle part of the project for which I am grateful.

Possibly due to various lacunae in supervision, I have relied heavily on the advice, guidance, support and encouragement of my colleagues within the Department of Archaeology. Worthy of particular thanks is Mike Church who has provided stimulating and challenging late night environmental discussion, over many pints of

Guinness, after dry and dreary evenings in the labs. He also helped tremendously with difficulties I was having with the phasing of the contexts on the Bostadh site. Mike has been consistently generous with his extensive knowledge of the archaeology of the Western Isles throughout my research and has always been accessible for advice and support. Denise Carruthers has been a constant source of encouragement, both in person and by email, and I would like to thank her here. Ruby Cerón-Carrasco and Denise Carruthers deserve special mention for the help and encouragement generously given during the final, stressful stages of writing, for which I am very grateful. Thanks are due to my colleagues working on similar projects from the Western Isles; Mike Church, Ruby Cerón-Carrasco and Adrian Tams; for support and advice and for access to unpublished work. I am particularly indebted to Tim Neighbour for advice, help, friendship, humour, mathematical chat and lunches throughout my research. I am grateful to Professor Dennis Harding and Tim Neighbour for permission to use their published illustrations and for facilitating this for me. I am grateful to Kevin Hicks for help with illustrations. Lucy Verrill helped with printing for which I am grateful.

I am very grateful to Ian Morrison for extensive computer support, laboratory assistance and last minute help with printing figures. My friend Frank McLaughlin has helped with early database difficulties and last minute software concerns and panics for which sincere thanks are given.

Specific zooarchaeological help and advice has been forthcoming from outside the Department of Archaeology from many busy people whose time and attention I was very grateful for. Thanks particularly to Ingrid Mainland, Julie Bond, Jacqui Mulville and Mark Beech for advice, encouragement and valuable zooarchaeological discussion. Julie Bond, Finbar McCormick, Murray Cook, Jacqui Mulville and Ingrid Mainland kindly allowed access to unpublished work. I would like to acknowledge members of the Zooarch mailing list for help with accessing publications not available in the library here, particularly Mark Beech, James Barratt, Ingrid Mainland and Terry O' Connor. I am of course especially indebted to the other people who have worked on faunal material from Atlantic Scotland without whose contribution my own research would have lacked direction. I am grateful to Jan Stora for sending me a copy of his PhD thesis and for advice on identifying seal bones. Jerry Herman assisted me with accessing reference material from the collection at the National Museums of Scotland and advised on some identifications.

Many of my very good friends provided wine and sympathy while I have been researching this thesis. I would particularly like to thank Susan Thoms, Debbie Hunter, Sorina Spanou, Frank McLaughlin, Rod McCullagh, Sally Foster, Sheila Noble and Louise Russell for their friendship, encouragement, humour and support throughout the years I have spent on this research.

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

Chapter 1 – Research design

1.1 Introduction

Chapter 1 introduces the main research design of the thesis and discusses the topics that will be addressed throughout the thesis, which deals primarily with the mammal and bird remains from two sites in the north west of Lewis. The sites are Bostadh, on the island of Great Bernera, off Lewis, and Beirgh, which is located on the Bhaltos peninsula in the north west of Lewis. (As far as the author is aware the pronunciation of the Gaelic names is "bosta", "beery" and "valtoss" respectively).

This chapter introduces the sites from which the material analysed in the thesis has been obtained, and introduces the structures and chronology of both sites. Some of the archaeological terms used are then discussed as some variation in terminology still exists in the periods and cultures that the thesis covers. It is hoped that the analysis of the bone assemblages will allow a number of research questions to be explored and they are listed in the remaining part of this chapter.

1.1.1 The material covered in the thesis

The title of the thesis uses the term "non-marine faunal evidence" a term initially favoured for its broad scope, and for the distinction it gives from the concurrent research conducted on marine faunal remains from the same sites (Cerón-Carrasco 2002) and on the botanical remains from the area (Church 2002). However, strictly speaking, non-marine faunal evidence would include invertebrate remains, which are not covered here. Any land snails recovered from the extensive sieving programme undertaken at one of the sites would have been examined with the marine molluscs (Cerón-Carrasco 2002) due to difficulties in separating the two during sample processing. Samples were taken, at one site, (Bostadh) for analysis of beetles and other insect remains, but none were retrieved (C. Warsop pers. comm.), presumably due to the free draining calcareous nature of the sediments. The research focuses primarily on mammal bones, as they were much more abundant than bird bones. The bird bones are dealt with differently from the mammal bones as is explained in 3.2.11.

1.1.2 The site at Bostadh Beach

Situated on the north-facing beach of Bostadh in Great Bernera, off Lewis (Figure 1.1), the site was excavated in 1996 by C.F.A. (Centre for Field Archaeology, then of the Department of Archaeology, University of Edinburgh, and now CFA Archaeology Ltd). Rescue excavation was carried out, because the site was eroding into the sea, and revealed a rectilinear building, extensive midden deposits and at least three figure-of-eight structures. The figure-of-eight buildings are overlain by middens believed, from the artefacts contained within them, to be Norse. The excavations were directed by Tim Neighbour. Most of the bone derives from the midden deposits. The structures and chronology are detailed below. The excavation remit was to save the exposed structures from further damage. The area surrounding the excavation area was not examined for structural remains. Some of the surrounding land had already been eroded by the sea; the remainder was safely preserved beneath the dune system. Hence, it is not known whether the excavated structures represent part of a larger settlement, or not. Likewise, there may have been further structures underneath the sand into which the Bostadh houses were revetted, one of the many disadvantages of excavating in the highly mobile environment of a dune system.

This thesis is one of three set up to investigate the environmental remains from the site, all funded by Historic Scotland. The other theses deal with the marine resources (Cerón-Carrasco 2002) and the soil micromorphology (Tams forthcoming). A fourth researcher has analysed the macrobotanical material from the site as part of a thesis on the archaeobotany of the Western Isles (Church 2002). It was envisaged that collaboration between these four specialists would produce an integrated picture of the environment and economy of the site. The hand-collected faunal material was assessed by AOC Scotland Ltd (Cerón-Carrasco 1997, Cook 1997a, O'Sullivan 1997). Unfortunately, an accurate assessment of the worth of the mammal and bird bones as PhD material was impossible due to the lack of a complete data structure report. This would have allowed a more complete and accurate assessment of the suitability of the material for doctoral research. In the event, after beginning the analysis, and after consultation with other faunal specialists, it became clear that there were insufficient bone fragments present to provide data worthy of doctoral research and further material was sought. This was provided by animal bones collected from excavations at Beirgh in west Lewis.

1.1.3 The site at Loch na Beirgh

Situated on a rocky outcrop in what is now a silted up lochan on the machair of the Bhaltos peninsula in north-west Lewis (Figure 1), the site was excavated by the Department of Archaeology of the University of Edinburgh. Research excavations took place between 1985 and 1993 as part of the Calanais Archaeological Research Project and revealed a multi-period site with a complex sequence of occupational layers (Harding and Gilmour 2000). There is evidence that the loch level has progressively risen while the site was occupied, resulting in a need to raise the floor levels. This has resulted in a series of occupation layers in which a distinctive structural sequence can be observed. Twelve phases of occupation were identified (Figure 5, illustrated in Harding and Gilmour 2000, 7 - 8) within the excavated layers before flooded conditions precluded further excavation. At the time of writing the remains of a complex Atlantic roundhouse stands on the site. Excavations were directed by Professor Dennis Harding, in conjunction with Ian Armit (1985 – 1988) and Simon Gilmour (1993 – 1995).

The animal bones analysed for this thesis were retrieved from contexts believed to date from Phase 5, the Final Cellular Phase. The material retrieved from the cellular phases was not closely datable (Harding and Gilmour 2000, 63). However, a date obtained from charcoal derived from Context 454 provided a radiocarbon date at the 2^{nd} σ level of 340 – 610 cal AD (Harding and Gilmour 2000, 62). The hearth deposits from which the charcoal was derived 'continued to accumulate... throughout the Final Cellular Phase' (Harding and Gilmour 2000, 63). The structures in this occupation phase include 'the shamrock' which comprises two attached cells and a forecourt to the SW, and a 'souterrain'. The plan of the latter follows the curving outline typical of many souterrains and its construction style, and central drain, is likewise typical (Harding and Gilmour 2000, 16). There are also two simple U-shaped cells, which abut the wall of the complex Atlantic roundhouse. All structures are situated within the walls of the complex Atlantic roundhouse.

Mammal bone retrieved from later occupation layers at Beirgh had been analysed before the current author's involvement in the project (Cook 1997b). The bones examined by Cook had been excavated from structures associated with two "figure-of-eight" buildings appearing above the Cellular phase in the structural sequence, still located within the walls of the complex Atlantic roundhouse.

1.1.4 The terminology used in the thesis

Throughout the thesis, the term 'Norse' is used to indicate all Norse presence, no distinction between 'Viking Norse' (the earliest raiders / settlers) and later arrivals is made. The word 'indigenous' refers to the people living on the islands when the Norse arrived. The terms 'Picts' and 'Pictish' are avoided owing to their strong cultural association with eastern Scotland and the relative lack of comparable cultural artefacts and associations in the Western Isles (Armit 1996, 162). For example, the symbol stones common in Perthshire, Fife and Angus and generally referred to as Pictish are much rarer in the Western Isles. The possibility that the lack of such stones in the Western Isles is due to the general unsuitability of the local stone (Lewisian gneiss) for carving, as opposed to reflecting a cultural difference is acknowledged (Ralston 1997). However, as the term 'Pictish' has 'cultural connotations which are not applicable to the whole of the Atlantic province' (Foster 1990, 143) its use will be avoided unless directly quoting other peoples' work. Even then the word 'Pictish' is often not intended to suggest any cultural or ethnic identity, but simply to denote a period of time from the third or fourth century AD to the arrival of the Norse (Harding and Gilmour 2000, 14). It is clear that what we now call the 'Pictish' state must have included peoples with a diversity of ethnicities, cultures and languages (Armit 1996, 162). Likewise, similarities exist between the material cultures of the various early historic people of what is now Scotland, such as the 'Picts' and the 'Scots' (Ritchie 1994, 27). In an attempt to circumnavigate the problems encountered when trying to marry historical and archaeological information the terms will be avoided wherever possible.

The term Late Iron Age is used to refer to the six centuries or so preceding the arrival of the Viking Norse in Atlantic Scotland around the 9^{th} century AD (Foster 1990, 143). As stressed by Armit (1990a, 2), the value of the term stems from its very looseness. It does not denote a major cultural change, but is the latter end of a continuum that stretches from end of the broch building period through to the Early Norse period (Ralston and Armit 1997, 218).

Various attempts have been made to categorise 'brochs', 'duns' and similar buildings in the past (summarised in Armit 1990b, 47). Most are largely discredited today due to the availability of recent information, derived from large-scale scientific excavations of sites such as Bu (Hedges 1987), Howe (Ballin Smith 1994), Scalloway (Sharples 1998), Dun Bharabhat (Harding and Dixon 2000) and Beirgh (Harding and Gilmour 2000). This work has revealed 'brochs' to be part of an evolutionary sequence of roundhouse structures, rather than a unique architectural form (c.f Mackie 1965). Armit (1990c, 437) has suggested that the term Atlantic roundhouse be used in place of the myriad of classificatory terms such as 'broch', 'dun' and 'island dun'. An effort will be made to follow Armit's nomenclature, and avoid typological terms such as 'dun' and 'broch' except when quoting other people's work.

For the purpose of discussing the occupation phases at Bostadh the terms "early", "ventral", "transition" and "Norse" are used. "Early" refers to the structures that appear to represent the earliest evidence of occupation discovered on site, while "ventral" refers to the Late Iron Age occupation of the "figure of eight" or "jelly baby" houses. The "transitional" phase is represented on site by middens, sand layers and a structure built within one of the ventral houses and appears to represent a time when at least part of the site had fallen into disrepair and had some temporary or "squatter" use of one of the buildings. The "Norse" phase is represented by a rectilinear building and extensive midden deposits containing recognisably Norse artefacts such as bone combs.

1.1.5 The biological nomenclature authorities

The Latin binomial is given for each animal and plant species when it is first mentioned in the text, thereafter the British common names are used. Taxonomic authorities are from Wilson and Reeder (1993) for mammals, Peterson (2002) for birds and Stace (1991) for plants.

1.1.6 Dating and chronology

Single entity AMS (accelerator mass spectrometry; Taylor 1987, 90) dates from cereal caryopses are the preferred dating method in Atlantic Scotland. Use of a single cereal caryopsis avoids both the marine reservoir effect and problems of bulk dates obtained from mixed samples (Ashmore 1999; Church 2002, 54). It is argued, also, that as caryopses represent one season's growth only, they give a more accurate date than would an animal that may have been alive for several years (Church 2002, 54). However, it could be argued that any such error, of a few years, will be undetectable within the range of dates that ^{14}C dating typically produces.

Wood charcoal is problematic for dating as there is a danger of getting dates that represent averages of dates of material from very different periods (Historic Scotland 2) particularly if charcoal from soil is used. It is therefore important to select charcoal from secure contexts only. Other taphonomic problems exist with charcoal. For instance, the death of a tree (the event that the ^{14}C dates) may have preceded the incorporation of the wood into a building (the event that the archaeologist is generally interested in) by many years. The use of animal bone for carbon dating would avoid such problems. However, as ruminants living near the coast commonly consume seaweed there is a risk that their bones may be contaminated with old carbon from the marine reserve, so producing an inaccurate date (Barrett et al. 2000b).

Arguably, the most persuasive argument against the use of animal remains for radiocarbon dating is the difficulty of relating deposits containing animal bones to any particular occupation phase of a site, far less to the construction of the structures. As Armit (1996, 145 – 146) writes:

> Given the investment of human and material resources in the construction of a deliberately monumental building it seems implausible that the structure would be allowed to fill up with domestic refuse. The idea of the wheelhouse inhabitants wading around in an unctuous ankle-deep soup of domestic waste does not sit easily with the care and organisation given to the construction of the home in the Hebridean Iron Age.

Therefore, plant material is preferred for radiocarbon dating, and charred cereal, regularly retrieved from sites where sample processing is done, is the most suitable material for the purpose.

1.2 The main research questions to be addressed through analysis of the faunal remains from Bostadh and Beirgh

1.2.1 Transition and continuity

Excavations at Bostadh disclosed layers dating from pre-Norse occupation, overlain by midden material identified by the artefacts within it as being putatively Norse and a possible Norse domestic structure, providing an opportunity to investigate the transition between the two cultures. Likewise, the evolutionary nature of the occupation at Beirgh, and the fact that faunal remains from other occupation phases have been examined (Cook 1997b), allows an unparalleled opportunity to examine continuity and change in diet and economy over several centuries.

Hunter et al. (1995) note that there are many reasons why a site should be used over a prolonged period. These include the availability of building stone from pre-existing structures, proximity to good land and the chance to benefit from any political status the site may have previously enjoyed.

Dockrill (1998) argues that the infilling of native structures, by an early Norse midden at Scatness, in Shetland, indicates an unbroken sequence of settlement over the archaeological interface between Norse and indigenous cultures. This is supported by the continued use and production of pottery artefacts throughout the Norse occupation layers.

Excavations at Brough of Birsay by Hunter (Hunter et al. 1995) demonstrated the co-existence between native and Norse cultures. Hunter (1986, 110 – 113) notes that although the incoming Norse rebuilt the walls of the indigenous structures they made an effort to reuse the existing floors. He goes on to argue that this is unlikely to have been in order to save quality agricultural land, the Brough being too heavily populated to have been a self-sufficient farming community (and therefore dependent on external contacts and trade). He argues that this re-use of already inhabited space indicates the 'retention of existing patterns', suggesting 'Norse settlement on the islands occurred under some form of controlling authority which was based on an established native system' (1986, 111). Excavations on the Brough largely happened during the 1970's, when building development (and planning permission) was strictly controlled and this may possibly have influenced his thinking. An archaeologist brought up under the British Conservative administration, with its lessened state control, who had seen visual footage of ethnic cleansing in Europe may have reached the opposite conclusion. Hunter (1986) remarks on the persistence of local pottery into Norse occupation layers suggesting that this indicates the survival of some indigenous culture, but concludes that the Norse occupation was 'intensive and dominant' (Hunter 1986, 173).

Noting that the artefact assemblage in the Norse layers at Buckquoy is dominated by indigenous artefacts Ritchie argues for considerable integration between 'native Picts and incoming Norsemen' (1977, 192). These differing interpretations of similar evidence illustrate the difficulties inherent in attempting to interpret social order from archaeological evidence. Gradual cultural assimilation, enslavement of indigenous artisans or the emulation of indigenous technologies could all have resulted in the presence of pottery and other artefacts in Norse occupation layers.

Similar archaeological circumstances existed at Pool, in Sanday, Orkney, where Hunter et al. (1995) found evidence of continuity in the use of local clays for pottery manufacture, and in the continuation of some aspects of animal husbandry. For example, the economics of cattle husbandry seemed essentially unchanged since the Neolithic (Hunter et al. 1995). The main change was that the cattle that survived to old age in the Norse period showed more signs of pathologies associated with their use for traction. Similarly at Buckquoy, Noddle (1977) discovered there was little difference in the animal bone remains between the two occupation phases. There is no reason to assume the indigenous and Norse interface period was the same over the northern and western islands of Atlantic Scotland (Bond 1998, 85; Morris 1995, 216).

Hunter et al. (1995, 274) observe that Pool 'joins a small but growing number of sites in the Northern Isles where Norse settlement represents the final phase of multi-period occupation'. They do not go on to speculate why the Norse phase was the final occupation phase at these sites. This may be an artefact of excavation choice, as farm mounds or other settlements, which are still occupied, are not generally selected for investigation by archaeologists. Also, the desertion of these small settlements during or after Norse occupation may simply represent a growing tendency for agglomeration in settlement style, and the growth of larger centres such as Kirkwall. Bostadh, too, seems to have ceased to function as a domestic site after the Norse occupation phase.

The faunal analysis will reveal something of the culture and economy of Bostadh and Beirgh. It may be possible to discern trends and developments in animal exploitation before the Norse arrival. Bostadh appears to have been occupied over a long period before the Norse arrived, providing an opportunity to look for change in the use of animal resources over approximately eight hundred years of indigenous occupation. Beirgh also appears to have been occupied over a long period although the bones from only one phase have been analysed for the purposes of this thesis, which will not allow for the detection of change over time. However, other preliminary faunal work has been carried out on assemblages from later occupation layers at Beirgh, which should allow such analysis to be carried out (Cook 1997b). It is anticipated that the analysis of the faunal remains from Bostadh and Beirgh will reveal evidence of continuity and change in the economy and animal exploitation over the first millennium AD.

1.2.2 The benefits of a mixed economy

It has been suggested that a mixed economy may allow a longer occupation series and enable a site to withstand economic and cultural change (Dockrill 1998). There is evidence from Orcadian sites that people relied on a mixed economic base (Morris 1995) with a mixed agriculture of pastoral and arable activity together with the exploitation of marine resources, birds and wild plants. Arguably, at the level of subsistence agriculture, which probably existed on these sites, nothing but mixed agriculture would be a feasible option. The dangers of over-specialisation are well-known and well-documented. In historic times, the Irish famine followed the devastation, in 1845 and 1846, of the potato crop by Late Blight *Phytophthora infestans* (Pears & Stickland 1999, 127; Salaman 1985, 291). The famine had considerable social and economic consequences and ended over two hundred years of almost total dependence on one crop by the majority of the country's rural population (Salaman 1985, 188 – 343).

The economic strategies in Bhaltos appear to have been opportunistic (Cerón-Carrasco et al. forthcoming) and it seems likely that the animal economy will reflect this. An attempt at a more specialised subsistence, by the Norse, may have led to the eventual abandonment of the settlement at Bostadh. Evidence from Greenland suggests that the Norse may have suffered from over-specialisation, which, in the harsh environment of Greenland led to their eventual abandonment of the site (Buckland 1983; Buckland et al. 1996). A similar, more recent example of the disastrous effect of specialisation in the face of climatic extremes was seen in Orkney in January 1952 when a gale removed 86,000 hens from the islands (Bond 1998, 81). Agricultural specialisation is not always a bad thing however, even in difficult climates. The last two hundred years has seen greater agricultural specialisation in Orkney, particularly over the last few decades when the area under cereal and roots has decreased drastically (Davidson and Jones 1985, 16). Greater concentration on grass for pasture, together with a preference for silage over hay, for rearing of beef cattle and sheep, has reduced the effect of the weather on farming productivity (Davidson and Jones 1985, 19). The traditional mixed agriculture 'would have been more at the mercy of the weather despite greater diversification' (Davidson and Jones 1985, 19). Crop failures were commonplace due to wet autumns preventing the harvesting of cereals and the drying of hay. Thus mixed agriculture may not always represent the most effective option in a harsh environment, a suitable specialisation may be more successful. Of course, the increased specialisation in Orkney was only possible because cereals and root vegetables could be imported from elsewhere, so, in the archaeological record it can be assumed that specialisation in agricultural production was accompanied by trading connections.

1.2.3 Animal husbandry methods

Some general information about husbandry methods at Late Iron Age Howe is given by the fact that there were high infant mortality rates (Smith et al. 1994; 147 - 9). Together with pathological evidence of osteoarthritis and spavin, this suggests that the husbandry methods were sufficiently good to maintain a breeding population, but perhaps not good enough to prevent a high rate of natural neonatal deaths. Further study of pathological data at Howe suggests that defective animals were allowed to survive to maturity, which might not have been the case had there been a surplus of animals, or an adequate supply of healthier animals. Alternatively, the high rate of neonatal deaths might have been due to the young animals being valued for their soft, supple, skins (Smith et al. 1994, 151).

Sheep bones 'were more common than those of cattle and pigs' in Late Iron Age Howe, in contrast to earlier occupation phases where cattle predominated (Smith et al. 1994). In the later phase of occupation more sheep survived to a greater age than did cattle, implying an increase in their use for secondary products, such as wool.

At the site south of Red Craig in Birsay Bay, cattle were found to be the most important food animal, in contrast to other sites around the bay where sheep would have contributed more to the diet (Morris 1995). The majority of the three main food animals (cattle, sheep and pig) were slaughtered young, indicating their prime value was as meat animals.

Rackham (1995) noted an increasing abundance of pig in the later phases of the site at Birsay Bay. Pigs were also noted to be increasing in the later phases at Howe (Smith et al. 1994). Smith notes that the trend for decreasing numbers of deer over time is accompanied by an increase in numbers of pig. She observes that the foraging behaviour of pigs might uproot the scrub habitat favoured by the red deer. At Bostadh, such questions can be addressed in conjunction with the archaeobotanical and soil evidence from the site. The analysis of the assemblages from Lewis will reveal whether the relative proportions of animals in each phase vary over time, and, if so, whether this correlates with other sites.

1.2.4 Red deer - hunted, traded or managed?

At Pool, red deer were present in small numbers but reached a maximum in the interface period between native and Viking (Hunter et al. 1995). All body parts and all ages of animal are present which suggests a local source. Furthermore, if deer were not available locally then hunting them would seem to require a large expenditure in travel time, which seems disproportionate to the contribution to the diet they appear to have made. Of course, social and cultural preferences for hunting deer may have made such journeys economically viable.

At Howe, a great reduction in the number of red deer was observed in the Late Iron Age, in comparison to earlier occupation phases (Ballin Smith 1994, 124; but see 2.2.2.2. below).

This continued steadily through time, and was accompanied by a general increase in sheep/goat numbers. The age at death of the red deer at Howe showed a high incidence of neonatal mortality, with 47% being killed in the first year of life. This may reflect herd management. Clutton-Brock (1979) interprets the foetal deer remains at Quanterness as being evidence of herd management. In addition, the high proportion of hinds killed between 4 – 5 years, and stags between 6 – 7 years reflects present day culling patterns (Youngson, pers com., cited in Smith et al. 1994). Neonatal and very young deer were also noted at Howe (Smith et al. 1994) and burning marks on their bones suggests they were roasted whole over a fire.

In contrast to Howe the Iron Age site at Cnip, another site on the Bhaltos peninsula, was found to have abundant red deer bones (McCormick forthcoming). Similarly, high proportions of red deer were found in an assemblage of animal bones from a later occupation phase at Beirgh (Cook 1997b). Likewise, preliminary faunal analysis revealed a large number of red deer bones in the assemblage from Bostadh (Cook 1997b). The high proportion of red deer appears to set the Iron Age sites in these areas apart from contemporaneous sites elsewhere in the Atlantic Scotland and an important part of the research will be an attempt to find out why this is the case. It has been suggested that red deer were managed on the island of Lewis in the Iron Age, thus maintaining a viable population (McCormick forthcoming).

The fact that Bostadh is on a small island could be thought to create problems when speculating on the origin of red deer remains in the archaeological record. However, the physical limits of the island may have been a benefit, assisting red deer management. Modern attempts to farm red deer have encountered difficulties due to the territorial nature of the animals (Clutton-Brock 1999, 204). Normally timid creatures the stags become aggressive and territorial at rutting time. The traditional deer park, where the animals can be restricted to a particular area, but not otherwise interfered with, seems to provide the best method of managing deer (Clutton Brock 1999, 205). An island would provide a natural example of such an environment (Smith et al. 1994, 149). In the case of Bostadh, however, the proximity of Great Bernera to Lewis may present a problem, deer being competent swimmers. This same proximity makes the possibility of deer hunting on Lewis, rather than Great Bernera, a viable option, not too expensive in effort or time.

1.2.5 Use of birds as a food resource

In Birsay Bay, Rackham (1996) found that the majority of the bird bones could represent a food source. Gannet, Manx shearwater and six auk species were retrieved. These birds represent the traditional fowling range of species obtained by harvesting nesting birds from cliffs. The environment around the sites of Bostadh and Beirgh would have provided suitable habitat for a range of nesting birds.

At Howe (Bramwell and Smith 1994, 153 - 157) 113 species of birds were identified from 1700 bone fragments. In the Late Iron Age phases the number of red grouse bones increased over time, while those of great auk decreased. The presence of bones from small birds in the deserted broch phase at the same site is believed to be due to the action of birds of prey. They are thought to have used the walls as plucking stands to aid dismemberment of their prey. Similarly, regurgitation of pellets, by roosting birds, such as owls, may contribute to the presence of small birds (and rodents) in an assemblage.

It is possible that the bird remains at Bostadh may indicate a change in use of this resource over the period of cultural change from native to Norse. Some species of domestic bird may have been introduced by the Norse to the islands. At Beirgh the lack of sieving of the deposits analysed for this thesis is likely to result in a paucity of bird bones, so it is unlikely that any deductions on the use of birds during this period of the site's occupation will be possible.

1.2.6 Faunal evidence of seasonality

Evidence of seasonal variation in diet and subsistence economy is often obtainable from the bird remains on an archaeological site (Serjeantson 1998, 23 - 26), and bird remains can provide environmental information on the available habitat types around the site (Clarke 1952). The presence of eggshell from sea birds (still a valued, if illegal, food source in parts of Scotland today), would indicate early summer food gathering. Bones from cliff nesting seabirds would indicate that these species comprised at least part of the summer diet. The presence of large quantities of waterfowl might represent a winter food resource as many species of swan, goose and duck over-winter in the Scottish islands (Bramwell and Smith 1994). Bramwell suggests that moorland birds, such as grouse, were hunted in the autumn. They could have been trapped by hawks or dogs.

Seabirds and grouse were also exploited in Westness, Rousay (Kaland 1995)

1.2.7 Other animals– pelts, pest control and hunting

The Norse site at Westness, on Rousay, Orkney, contained faunal evidence of the hunting of red deer, whale, seal and otter (Kaland 1995). The bone assemblage at Howe (Smith 1994) contained seal bones, including juveniles, with butchery marks. This suggests they were used for meat and blubber as well as for skin and fur. Foxes, otters and cats seem to have been used for their pelts at Howe (Smith et al. 1994).

The dog bones at Howe (Smith et al. 1994) indicate large dogs, which could have been used for hunting. The relatively small quantity of dog bones retrieved suggests the animals were disposed of offsite, or at least not deposited with kitchen or butchery refuse.

The presence of otters at Bostadh has been noted (Cook 1997a). Examination of these bones should reveal whether they have been skinned. Body part analysis may suggest whether they were present as complete carcasses or were likely to have arrived on site as imported skins (with skulls and feet attached) as has been suggested at Dun Vulan.

1.2.8 The social and symbolic functions of animals

The presence of exotic species can be interpreted as evidence of the high status of a site. It is both difficult and possibly misleading to attempt to interpret social customs and mores from animal remains. However, there would seem to be an argument for the idea that certain animals denote sites of higher status or, at least, greater wealth. The large size of a cow makes it a high investment animal to feed. It will tend to be found in sites which may be argued to be richer (at least in fodder) than sites which have only sheep or pigs on them. There is literary evidence from Tacitus (cited in Smith 1994), that the *Germani* gave gifts of cattle to their chiefs.

Caution should be exercised when attempting to assign "value" to animals in the past as relative importance of animals may vary through time. This is illustrated by the domestic cat, which, despite being greatly appreciated today as pets around the home, and valued as working animals in farms, grain-stores and distilleries, is commonly available "free to a good home". In contrast, Irish legal texts, from the 7th and 8th centuries AD, indicate a cat is worth the same as three cows if it can both purr and hunt rodents, and still worth one and a half cattle if it only does the former (Kelly 1998, 122). The perceived value of the cat in ancient Egypt is well known and abundant archaeological evidence suggesting its prestigious position in society exists (Serpell 2000, 182 – 185).

Bramwell and Smith (1994) give an example of how animal remains might reveal something of the status of a site, at Howe the presence of a goshawk is interpreted as possibly representing a prestigious object. The goshawk is only an occasional visitor to Orkney, so it is likely to have been traded from elsewhere. This is in contrast to birds such as kestrels or peregrines, which could have been caught and trained locally.

Deposits of complete or articulated animal carcasses tend to cause problems for archaeological interpretation. The chance that an animal has just suffered an accidental death always exists. Alternatively it may have been killed for the skin, or because it represented some type of threat (disease, rival predation etc). The carcass may then have been dumped, intact. Similarly, an articulated skeleton may represent an animal with a close association with humans, such as a dog, horse or hunting hawk. Such animals might be treated differently in death from the kitchen debris that normally comprises an archaeological midden deposit. Alternatively the animal may have been killed with the intention of consumption, but the flesh discovered to be tainted or purulent due to disease. There is furthermore, always a chance that the animal may represent a ritual deposition. The interpretation of such an event is often based on subjective judgements, and could be argued to be, in part, dependent on the imagination of the analyst working on the material.

Certain faunal data are interpreted as evidence of status in Dun Vulan, South Uist, where it is suggested that they played a symbolic role and were evidence of the high status of a site (Mulville 1999, 274). Pig bones have been found inside the broch at Dun Vulan (Mulville1999, 253) and at Howe where an almost complete skeleton was found in a context associated with a 'possible period of abandonment' of the broch (Smith et al. 1994, 142). Smith notes this skeleton displayed signs of arthritis, which can taint the flesh, and consequently does not ascribe any symbolic importance to its deposition.

The presence of cat skeletons within the walls of buildings was recorded at Howe. The custom of building dead cats into the walls of houses, as a protection against rodent infestation, has been noted in more recent times (Clutton-Brock 1981). A great increase in the number of rodent bones on site is noted in the last few phases at Howe, correlating with an increase in the number of cat bones on the site.

1.3 Conclusion – the research potential of the bird and land mammal remains from Bostadh Beach and Loch na Beirgh

In the first part of the chapter the sites from which the assemblages derive were introduced and the archaeological terminology that might be construed as ambiguous was explained. The biological authorities used are listed and the dating methodology explained briefly.

The second part of the chapter introduces the research questions. There are three foci of research interest; animal husbandry; the use of natural animal resources; and faunal evidence for activities not related to food procurement. This latter category includes any social evidence that may be obtained from faunal remains. The important issue of chronological change is part of most of the research questions asked.

The questions on animal husbandry to be addressed deal with the methods used, the relative importance of various species and the nature of their exploitation, whether for meat or for secondary products. They are also concerned with whether sufficient resources existed to keep them over the winter. Evidence of seasonal exploitation of husbanded species will probably be present.

The exploitation of natural resources is primarily concerned with the use of birds and their products. It will also include animals hunted for their skins, such as otters and seals. Such species also provide important seasonal evidence.

In the case of red deer, it is not yet clear whether they represent a husbanded species or a natural resource. This may be one of the key areas of research interest in itself. The faunal evidence should answer general cultural and economic questions as well as providing some indications about deer management or hunting. If there was evidence of large dogs on site then the hunting of red deer would presumably have been possible. Certain types of slaughter (age at death) curves might indicate management of the animals.

The use of faunal evidence to define social or cultural conditions such as status, trade and ceremony is contentious. However, the evidence from Bostadh and Beirgh may provide useful comparative data for other recently excavated sites where such interpretation has been carried out.

An attempt has been made here to categorise the research questions when in fact such questions often overlap. For example, the discovery of a cat skeleton in a house wall may reveal a number of things. These might include the ritual burial of cats in walls to ward away rodent pests, the different status of cats to other domesticates, or the natural tendency of cats to die in quiet, inaccessible places. Such equifinality is a source of concern in archaeology and remains an essential part of theoretical debate (Dincauze 2000).

The analysis of the land mammal and bird remains from Bostadh and Beirgh will contribute to our understanding of the Late Iron Age to Early historic period in the Western Isles. Specifically, evidence of economic and environmental change over time is likely to be revealed. Together with the other environmental evidence, it is hoped that a reconstruction of the economy and natural environment of the site during occupation can be built up. A range of questions relating to change over time, particularly the transition between the indigenous and Norse economies can be addressed.

The general research design for the bird and land mammal analysis must remain flexible. An attempt has been made in this chapter to illustrate the type of questions that may be addressed through faunal analysis of sites from the Scottish Atlantic Iron Age. The results from the general environmental and faunal work at Bostadh beach and Loch na Beirgh will allow comparison with what is known of that time period elsewhere in Atlantic Scotland.

Chapter 2 – The archaeology and environment of the Western Isles considered in the Atlantic Scotland setting

2.0 Introduction

This chapter reviews the natural environment of the Western Isles today and attempts to reconstruct it in the Atlantic Late Iron Age. Geology, topography, climate and vegetation are all considered with a view to understanding their implications for the archaeology of the north west of Lewis. The second half of the chapter discusses Late Iron Age sites in north Atlantic Scotland in the context of the animal bones analysed from their Late Iron Age occupation levels.

2.1 The natural environment of the Western Isles and its influence on archaeology

The natural environment of the Western Isles is highly dynamic and has undergone numerous changes in the seven to nine millennia the islands have been settled (Armit 1996, 36). Undoubtedly the local natural environment plays an important role in human life. Indeed, many believe it constrains or determines much of what human beings can achieve. This environmental determinist viewpoint will not be subscribed to here; instead, an environmental possibilist stance will be taken (Reitz and Wing 1999, 13), suggesting that rather than determining how humans live, the environment provides both possibilities and constraints within which human societies can function. Decisions made by humans are restricted by the natural environment that surrounds them, but are influenced by other social, economic and cultural factors (Edwards and Ralston 1997b, 2). 'The reciprocity between any creature and its environment is an inescapable fact of existence' (Dincauze 2000, 18). Humans can be regarded as being in the ecological framework along with other animals modifying and being modified by the environment (O'Connor 1991b, 3). Therefore, while edaphic and climatic conditions may set limits on economic development, and topography might constrain the situation of a settlement (Armit 1996, 18; Armit 1998), these limitations can often be overcome through technology. For example, soil may be fertilised and its texture improved, through the addition of substances such as seaweed, manure, composted vegetation, sand or lime (Simpson et al 1998; Fenton 1997, 58, 274, 281). Similarly, it may be possible to use technology to overcome climatic disadvantages, particularly that "symptom" of climate perceived as weather. Examples of technological adaptation to inhospitable weather include digging houses into sand dunes or middens for protection against the prevailing winds. Likewise, the inherent instability of dune systems may be overcome by building structures upwards, over the encroaching wind-blown sands. Both these methods have been used in the Western Isles during the Late Atlantic Iron Age to combat the persistent wind that is a ubiquitous feature of the Atlantic climate.

2.1.1 The geology and topography of the Western Isles

2.1.1.1 The underlying geology

The Western Isles are comprised of a variety of types of metamorphic rocks known as Lewisian gneisses, believed to be over 3000 million years old (Armit 1996, 21). Some are metasediments - metamorphosed sedimentary rocks, while others are igneous in origin. The metasediments include calcareous, and graphite bearing, gneisses and garnet bearing schists that have eroded to form the gently undulating landscape, which typifies central Lewis (Gribble 1991, 16). This landscape contrasts with that of South Harris, which contains some of the highest hills in the archipelago, made of much more resistant rocks, which are comprised of a complex of igneous rocks intruded into the metasediments (Gribble 1991, 16). Other high hills, for example in South Uist, are formed by gneisses toughened by metamorphic activity in the region of the Outer Hebrides Thrust zone (Gribble 1991, 17).

The bay on which Stornoway is located is made up of younger, sedimentary rocks, which lie unconformably on the Precambrian gneisses (Gribble 1991, 14). These sedimentary rocks are sandstones, and provide richer soils than the thin, acid soils produced by the gneisses. This may account for the area around Stornoway being one of the earliest settled in the Neolithic (Armit 1996), raising the question of whether the potentially greater geological richness of this area has affected its later denser settlement.

2.1.1.2 The topographic features – the glacial landscape

Perhaps the most striking topographic feature of the island chain is the glacial landscape. The combination of underlying geology and glaciation explains why uniformity is not a strong feature of the islands, which present varied topographical features. The harsh, sculpted, erosional-zone landscapes of the archipelago include the u-shaped and hanging valleys of Lewis and Harris, their huge erratics and hillsides stripped of soils, and the softer, knock-and-lochan topography of North Uist (Hudson 1991, 19). The islands also have areas of Pleistocene glacial deposition, including an extensive plain of till deposition on Lewis and mounds of morainic drifts in the Uists and Benbecula (Hudson 1991, 19). The southern islands represent an environment greatly affected by post-glacial factors with their extensive machair plains being the product of formation processes occurring over the last few thousand years. Glacial geomorphological evidence suggests that a local ice cap formed over Harris and much of Lewis during the most recent glacial episode (von Weymarn 1979).

2.1.1.3 The topographic features - the machair

The machair system, comprised of dunes and grasslands, fringes almost the entire west coast of the island group (Ritchie 1991, 5, Fig 1b). The term "machair" results from the 'accidental appellation of extensive coastal sand plains in the Inner and Outer Hebrides by Gaelic speakers' (Ritchie 1976, 434). Machair can be defined in a number of different ways; geographers, botanists and the people living on or near it tend to have different definitions (Owen et al. 1996, 125; Ritchie 1976, 432 - 434). Ritchie (1976) defined machair using a suite of physical, chemical and botanical criteria. These included the presence of a shell-rich, blown sand, a lime-rich soil with a morphologically mature, near-level surface and a pH of >7.0. Ritchie (1976, 435) advises that the word machair should be used as an adjective, as in "machair plain" and "machair hill-side", and that "machair" should not be applied to the dune system (Ritchie 1979, 107). Both practices will be followed here.

The machair plain lacks the psammophilous grasses, such as marram, which stabilise the wind-blown shell sands of the dunes. In a cool, oceanic climate this dune stabilisation eventually builds up a characteristic soil system with calcium rich soils supporting a range of plants. By necessity, this is a simplification; more detailed models of machair formation are provided elsewhere (Ritchie 1979). Ritchie (1976) cautions against using botanical criteria to define machair plains since the range of plant species present is affected by land use and climate. For example, machair land is commonly used for grazing animals, which has a huge effect on the plant species that can thrive. Ritchie (1976, 435), regards the Hebridean machair system as part of a continuum of coastal landscapes stretching to the south of England. A post-glacial, dynamic landscape system, the machair originated almost six thousand years ago (Ritchie 1979, 115) and has experienced long periods of stability interrupted by occasional short periods of deposition and erosion (Ritchie 1979, 115; Gilbertson et al. 1995). Nearly the entire length of the west coast of the southern islands is comprised of machair land, from North Uist down to Barra. Most of the west coast of Harris is machair, and there are occasional, localised patches on Lewis, particularly in the study area, the northern part of the west coast (Owen et al. 1996; 124). Mather and Ritchie (1977) recorded 6000 hectares of machair on the Western Isles.

The calcium carbonate content of the machair soils, which can be as high as 80% (Owen et al. 1996), makes them less than ideal for crop production. Most plants will grow on sandy soil if plenty of organic material is incorporated to improve its ability to hold water (Hamilton 1987, 92). Sandy soils are more fertile than the acid soils that derive from the gneisses and blanket peats further inland and their paler colour results in them warming up faster in the springtime. Acidic, peat-derived soils are often moisture retentive and this too can be improved by the incorporation of organic matter (Hamilton 1987, 93). Seaweed is a nutrient rich source of organic matter which can be used fresh or composted (Pears & Stickland 1999, 55) and is abundantly available in the islands. The best soils are found where these two landscapes meet and the calcium carbonate-rich machair soils help to neutralise the acidic peat-derived soils (Owen et al. 1996).

Machair landscapes are significant to archaeologists in three ways. The dynamic nature of the landscape can assist archaeological investigation by covering sites rapidly and concealing them from view completely for many centuries, as has been the case at Bostadh. Likewise, at Beirgh, the formation of the machair at Traigh na Beirgh, corresponding to Ritchie's (1979) second model, has led to the silting up of Loch na Beirgh and nearby Loch na Cuilc (Harding and Gilmour 2000, 3). Archaeological evidence suggests that the concomitant rise in the level of Loch na Beirgh threatened to flood the occupation levels in the structures on several occasions in the past. The resulting raising and infilling of floor levels provides a great depth of stratigraphy, and clearer occupation horizons than would have otherwise been the case (Harding and Gilmour 2000, 4).

It can be argued that the instability of the machair plain can assist in archaeological interpretation, as seen above. However, the rapidly deflating machair plain on the Bhaltos peninsula today, destabilised by grazing by sheep and rabbits, and encroached by the sea, is threatening archaeological sites in Bhaltos (Armit 1994, 72) and throughout Atlantic Scotland. In addition to concealing and physically preserving archaeological sites the calcium carbonate rich machair soils lead to very good preservation of bone. In most machair environments other organic material, notably pollen and uncharred macroplant remains, are not preserved except in exceptional circumstances. One example of which would be the anaerobic conditions resulting from the rising water table at Beirgh, which have led to remarkably well conserved organic material, such as wood, in the lower, waterlogged levels of the site. Dynamic machair systems therefore affect archaeological remains in three ways; they can swamp and conceal a site or erode and destroy it. In addition, they can often assist in the chemical and physical preservation of archaeological remains, ranging from monumental structures to tiny ecofacts.

2.1.1.4 The topographic features – the peat

Peat soils form under waterlogged conditions and have an organic O-horizon of > 40 cm (O'Hare 1988, 43), and can be classified either according to how they originated, or according to their acidity level. Blanket peat, also known as climatic peat, is extensive throughout the Western Isles. It is formed in wet, humid conditions, where high precipitation and low evapotranspiration rates lead to saturation of the land surface. Such conditions, in turn, result in anaerobic conditions that prevent the complete decomposition of plant material (Fitzpatrick 1980, 227; O'Hare 1988, 33). Deriving their water from rainfall the blanket peats are invariably acidic, as opposed to basin peat which derives water from groundwater flow from surrounding areas as well as from rainfall. The mineral content and pH of this water affects the acidity of the peat, and if the water derives from limestone or chalk areas then the pH of the peat may be neutral or even alkaline (Fitzpatrick 1986, 183). Peat can be cultivated, but usually needs drained; acid peatland, which is most common in Scotland, also needs to be limed to increase the pH level.

Peat is of considerable archaeological significance. Like machair it can cover and protect upstanding archaeological features, most notably, in Lewis, the stones at Calanais were standing in 0.5 m of peat when they were excavated in 1857 (Armit 1996, 81). The greatest archaeological significance of peat is its preservation properties, particularly of organic material, exemplified by the bog bodies of Denmark. Pollen is also well preserved in peat, leading to a concentration of palynological activity in boggy areas, which can have taphonomic implications for the interpretation of pollen diagrams and the tendency to detect changing climate through their interpretation. Increases in the detected frequency of pollens from wetland plants, such as heather (*Calluna* / *Erica* spp.) and alder (*Alnus* sp.) may be caused by "hydrological changes of a local nature" (Whittington and Edwards 1997, 17) rather than reflecting larger scale climate change or a widespread increase in wetland. Peat can also preserve macroplant remains such as tree stumps and branches (see 2.1.3 below) but, unfortunately, for this study, it destroys bone very quickly. This, combined with the opposite preservation capacity of machair (see above) makes the integration of environmental evidence difficult at a local level, and limits zooarchaeological investigations in the Western Isles largely to machair sites.

A considerable expansion of peat is reckoned to have occurred in the mid to late Holocene throughout north west Europe as a result of climatic changes increasing the precipitation and / or reducing evapotranspiration (Ellis and Mellor 1995). Human activity can dramatically decrease evapotranspiration rates by reducing woodland cover, thereby reducing transpiration rates and increasing the amount of water in the soil. Extensive peat development in the Western Isles appears, from palynological evidence, to have started around 7000BP (Birks 1991, 36). The machair was well established by 5000BP (Ritchie 1979, 115). Opinions differ on the date at which the islands became cleared of their larger tree cover (see 2.1.3. below) but it is generally agreed that the soils and topography of the area have experienced little or no major overall change since the Atlantic Late Iron Age. Localised landscape alteration will have occurred, often due to human activities, but the overall landscape and resource base is likely to have been similar to that observable today. The vegetation cover is likely to have changed over that period however (see 2.1.3 below).

2.1.2 Climate

Despite their northerly latitude, the Western Isles have a reasonably mild, oceanic climate and benefit from their proximity to the Gulf Stream. "Climate" is an intangible, statistical phenomenon, a generalisation of the weather systems that affect human societies. In the Western Isles these weather conditions are compounded by the open, largely treeless landscape that accentuates the high winds, which occur all year round, and result in a highly changeable weather system. Consequently, the weather can vary greatly within the region and throughout any given day. Air temperatures tend to be more influenced by sea temperatures than by sunshine, resulting in the highest average temperatures occurring in July and August (12.9°C) despite the sunniest months being May and June (Angus 1991, 30). The average temperature in the coldest months (January and February) is 4.1°C, giving an average annual range of 8.8 degrees centigrade, one of the lowest in Britain (Angus 1991, 30).

The average wind speed at Stornoway is 14.4 knots (Birse and Robertson 1970, cited in Angus 1991). Gales are recorded on an average of one day in six at the Butt of Lewis and one day in eight in Stornoway (Birks and Madsen 1979, 826). A wind is defined as a gale if it sustains a speed of 34 knots over a ten-minute period. Rainfall varies between 1000mm to 2400mm annually on average (Angus 1991, 28) with the low-lying land in Lewis receiving the least and the highest precipitation falling on the high mountainous regions in Harris. Two hundred days a year, on average, can be classed as "wet", having more than 1mm rainfall, while 263 days have measurable rainfall, i.e. greater than 0.2mm (Angus 1991, 28). Water is lost from soil through evapo-transpiration at a relatively low rate in the islands, and this is significant for the ecology of the area. When rainfall exceeds evapo-transpiration losses there is a Potential Water Surplus (PWS) and a Potential Water Deficit (PWD) occurs if the reverse is true (Green, 1964, cited in Angus 1991). Rainfall equals or exceeds evapo-transpiration in all months of the year in most of Lewis, Harris and South Uist (Angus 1991, 28). The upland areas of these islands have a high PWS, greater than 500mm, even in the summer months (Angus 1991, 28). Such water surpluses have led to soil leaching and peat formation over the years.

2.1.3 Vegetation

The Western Isles tend to be regarded as a homogenous unit when considering geology, climate, topography and vegetation. In the case of the first three, large-scale phenomena this is probably quite justified. It is less so in the case of vegetation, as the archipelago stretches some 190km from north to south, covering latitudes corresponding to Cape Wrath in the north and Fort William in the south. On the Scottish mainland these latitudes encompass a range of vegetation groups, from oak dominated forest, through pine and beech woods to the treeless "flow country" in the north (Bennett et al. 1990, 281). There is, therefore, no reason to assume the whole of the Western Isles was of uniform vegetation cover in the past.

2.1.3.1 The post-glacial vegetation history of the Western Isles

Just as it cannot be assumed that the Western Isles were not of uniform vegetation cover in the past, as they are not today, so it cannot be assumed that vegetation cover has been constant over the post-glacial period. For example, there is some evidence of denser tree cover existing in the past. There is general agreement that plant species, including trees, colonised the remoter islands of Atlantic Scotland reasonably slowly after the ice retreated, reaching a peak between *c.* 7,000BP and *c.*5,000BP (Tipping 1994, 17; Bennett et al. 1992, 241; Wilkins 1984, 257; Birks and Madsen 1979). At the time of greatest post-glacial tree cover there was a denser cover of birch / hazel / willow scrub in favourable, sheltered locations in Lewis, than there is today (Birks and Madsen 1979, 839). In South Uist it is thought that up to half the landscape might have been covered with woodland, dominated by hazel, birch and willow scrub (Bennett et al. 1990, 281). Direct physical evidence that tree cover in the Western Isles was denser in the past is available in the form of tree stumps and branches buried in blanket peat as well as in organic sediments below the high water mark

(Personal observation 1993; Whittington and Edwards 1997, 15; Wilkins 1984, 254). The stumps and roots come from pine trees over 30 years of age at death and radiocarbon dates from them vary between 4870BP to 3910BP (Wilkins 1984, 254), well before the study period. The details of the variation in woodland density and species diversity in the Western Isles throughout the early and middle Holocene are beyond the scope of this thesis and are discussed elsewhere (Birks 1991, Bennett et al. 1990, Bohncke 1988, Wilkins 1984, Birks and Madsen 1979).

It is generally agreed that from *c.* 4,000BP tree numbers have declined in Atlantic Scotland (Bennett et al. 1992, 241; Bennett et al. 1990; Wilkins 1984; Birks and Madsen 1979). Palynological evidence suggests that vegetation history of the last four thousand years in the Western Isles has been one of progressive impoverishment (Birks 1991, 37). The islands seem to have been largely treeless for the past 4,000 years, according to both the macroplant evidence (Wilkins 1984, 256) and the palynological record (Birks 1991, 36; Bohncke 1988, 453; Birks and Madsen 1979, 839). In his 1994 synthesis of Scottish woodlands Tipping (1994, 12, Illus. 3) places the Western Isles well within the zone of open birch/hazel scrub at around 3000BC, well before the study period.

2.1.3.2 The vegetation of Lewis in the Late Iron Age

While it appears that there has probably never been dense forest cover in west Lewis during the present interglacial period (Birks 1991, 35; Birks and Madsen 1979, 825) it is probable that tree cover may have been denser in the Late Iron Age than it is today. It seems likely, even at an intuitive level, that the landscape will have altered as a result of over three millennia of agricultural activity and that some of that change will have occurred in the most recent millennium. While pollen analysis is well suited for giving a broad picture of change over time, it is less able to detect local diversity over shorter periods. Other forms of evidence, therefore, become useful when considering whether vegetation cover has changed on a local scale in the last 1,000 years.

Certain factors that affect tree growth today are also likely to have operated in the Late Iron Age. The high average wind speeds tend to inhibit vertical plant growth and encourage the horizontal growth of dwarf forms (Angus 1991, 29). Wind also affects vegetation by carrying salt in from the ocean. This can stunt or "burn" plants as well as influencing the vegetation type growing in an area, encouraging the growth of salt-tolerant plants further inland than might otherwise be expected. The oceanicity of the climate also results in the existence of mountain-dwelling plant species at lower altitudes than elsewhere. As mentioned above, Ritchie (1976) observed that machair land had distinctive vegetation and noted that machair grasslands of the Western Isles had a more restricted flora than did other dune grasslands, which can support a large and diverse flora. Ranwell (1974) noted that large dune systems could support between four and five hundred species of vascular plants, whereas the machair system typically supports 100 – 150, usually indigenous species.

Evidence that suggests that trees are rarer today than they may have been in the past is the correlation between treeless landscapes and intensive grazing by sheep. Writing about Shetland, Bennett et al. (1992, 267) note an increase in plants such as *Juniperus communis* L. and ferns including *Polypodium* spp. and *Filipendula* spp. in areas free from grazing by herbivores today. Birks and Madsen (1979, 826) make the same observation about the Western Isles. They note that there is a wider range of large, upstanding vegetation, including small trees such as willow and birch, as well as ferns and tall herbs, on islands in the bigger lochs. Similarly, seedlings protected by rocks, or growing in inaccessible cliffs, can often survive ovigenic destruction in the form of grazing and trampling and grow into shrubs or small trees. The current writer has observed this on islands in lochs in west Lewis. Birks (1991, 32) notes that in inaccessible areas such as rocky glens, cliff tops and islands in the larger lochs, many species of scrub vegetation exist, including "dense stands of" willow (*Salix aurita* L. and *S. cinerea* L.), and scattered bushes of beech (*Betula pubescens* L.), hazel (*Corylus avellana* L.), honeysuckle (*Lonicera periclymenum* L.), aspen (*Populus tremula* L.), dog-rose (*Rosa afealina* L.), rowan (*Sorbus acuparia* L.) and bramble (*Rubus fruticosus* L.). It can be argued that grazing pressure, mainly by sheep but also by rabbits and geese, may be the biggest factor, after glaciation, involved in creating the modern landscape of the Western Isles. As pollen records provide "an integrated record of *regional* vegetation over a large area" (Birks 1991, 35), while macroplant remains, such as tree-stumps in peat, indicate local vegetation, it may never be possible to reconstruct accurately the vegetation patterns of the Late Atlantic Iron Age. However, it is important to remain aware that the plant resources available, including round woods and timbers, may have been greater in the Late Iron Age than they appear to be today.

2.1.4 The potential resources available in Lewis

The challenging soils of the islands, both the waterlogged, acidic peats, and the free draining, basic machair soils would have responded to alteration by people. Examples of such alterations can still be seen today in the inappropriately named "lazy-bed", a hand-cultivated ridge over a metre in width, created by digging two parallel trenches into the peaty turf, then folding the turf over towards the centre. These beds tend to occur where the acidic peat has been neutralised somewhat by the windblown sand of the machair system. They would have been worked by hand and fertilised with seaweed (Cerón-Carrasco et al. forth.) among other things. Armit (1994, 73) argues that an increase in the economic value of seaweed, resulting from the kelp industry, led to less being used as fertiliser for the machair plain, which, in turn contributed to increased rates of deflation of the machair land in the fifteenth to nineteenth centuries when deflation rates are thought to have been greater than they are today (Ritchie 1979).

Although the Western Isles may strike the visitor today as a bleak and barren land it does have a rich resource potential (Cerón-Carrasco et al. forth.). Arguably most important, particularly in the prehistoric past, would have been the coast, providing fish, molluscs, seaweed, driftwood and a range of other plants as well as birds, eggs and sea mammals. As argued above there may have been greater wood and timber resources than are evident today. An important source of wood is driftwood, which was perhaps more abundant in the past than it is today. Depending on weather conditions and erosion forces operating around the Atlantic Ocean there may have been substantial quantities of trees and branches available from the sea. For example, the beaches of Washington State and British Columbia are today littered with large, complete, trees and felled logs, presumably a result of the dense forestation of the Pacific North West. The Atlantic might also have produced such a resource when trees were more abundant. The machair plain would have provided grazing land for herbivores, providing, meat, milk, wool, leather and possibly traction to help work the difficult local soils. The climate and soils did not preclude the growing of crops, and non-cultivars may have been exploited for berries, bedding and herbal remedies.

2.2 The archaeology of the area

2.2 1 North Atlantic Scotland

2.2.1.1 The importance of the archaeology of the north Atlantic province

Atlantic Scotland is defined as being the northern and western areas of the mainland plus the island groups of Scotland, including Shetland, Orkney, Caithness, the Western Isles and the west coast of Scotland south to Argyle (Piggott 1966; Armit and Ralston 1997). This thesis will concentrate on the northern part of the area, primarily the northern isles of Orkney and

Shetland and the Western Isles. The archaeology of Atlantic Scotland has long been recognised as being of interest and has attracted the attention of antiquarians and archaeologists for over a century (Anderson 1878; Fergusson 1878; Scott 1947; Mackie 1965; Armit 1990; Armit 1996; Harding and Gilmour 2000). The area contains many large, well-constructed monumental structures that have survived to the present day due to a particular set of environmental and human circumstances.

2.2.1.2 Reasons for the survival of monumental architecture in northern Atlantic Scotland

In many areas of Atlantic Scotland, particularly in Orkney, Caithness and parts of Shetland, the local sandstone provides a strong, fissile building stone. Easily broken into large flat-sided stones they lend themselves to detailed construction methods, for example the employment of the architectural technique known as corbelling. Corbelling allows walls to be built inwards towards the centre of the room reducing the area requiring roofing. A good example can be seen at the Orcadian Neolithic burial cairn of Maeshowe.

It seems likely that a combination of a relative shortage of wood, plus this abundance of readily available building stone would have made the architectural styles and typically solid, durable, structural types feasible. Certainly, the monuments owe their longevity to the fact they are built from stone rather than wood, together with their occurrence in areas that are remote from the industrialised and heavily urbanised centres of the British Isles. In places where the pressure on land is less intensive, with less building development, and agriculture more pastoral than arable, more evidence of older structures may be expected to survive. These areas, or "zones of likely survival" (Edwards and Ralston 1997b, 4) are a valuable resource in the Scottish archaeological record, contrasting with the more populous lowland "zones of likely destruction" where archaeological traces are more subtle (Edwards and Ralston 1997b, 5). Here, heavy demands on land, for building space and industrial development, may be expected to result in the destruction of old buildings and the development of land containing traces of previous occupation.

One human factor that may be said to have aided the preservation of these structures is the attitudes of the local people to archaeological remains. The presence of large standing stones and various mounds, some of which have entrance passageways still visible, seems to have captured the popular imagination and resulted in the emergence of a wide range of superstitions and folklore around these features. This is certainly the case in the Northern Isles where folk tales and legends associated with prehistoric structures are abundant.

Giants and trolls arrived in Orkney and Shetland, from Scandinavia, with the Norse, adapting considerably to fit into the gentler, lower landscape of the islands (Marwick 1975, 30). Giants largely died out or turned into standing stones, with relict populations remaining in the more mountainous regions such as Hoy, Rousay and Unst (ibid., 30). Similarly, Marwick observes that trolls, or *trows*, decreased sufficiently in size to inhabit the abundant mounds and tumuli of the islands, which they shared with *hogboons* (from the Old Norse *haug-búi* – mound dweller). Legends concerning these prehistoric knolls tend to revolve around the mythical creatures that dwelt in the mounds rather than on the structures themselves. Numerous superstitions also existed concerning standing stones (Marwick 1975, 58 – 62), with them playing significant roles in marriage, New Year celebrations and general good fortune.

Fojut (1986, 44 - 45) writes that in Shetland there is consistency in which mythical creatures are associated with the different site types. *Trows* / trolls and *peerie folk* are associated with pre-Iron Age structures and "Picts" are allied with Iron Age sites. He observes that "prehistory, history and tradition are woven together" in Shetland (1986, 46).

These tales probably evolved as moral warnings against strong drink and libidinous behaviour, revolving, as many do, around occasions, such as Hogmanay, weddings and other celebrations, when drink (and music for dancing) would be present. However, it can be argued that such attitudes and legends would have served to protect archaeological structures from disturbance by local people in the centuries before the recognition of the structures as of archaeological interest and the subsequent state guardianship of monuments. It can be imagined that even if an individual did not hold these beliefs themselves they might be unwilling to incur the wrath of the larger community by damaging these significant structures in any way.

2.2.1.3 A summary of recent thinking on the archaeology of the Late Iron Age in north Atlantic Scotland

It is beyond the scope of this thesis to describe in detail the archaeology of north Atlantic Scotland in the Late Iron Age as it is comprehensively covered elsewhere. Harding (1990), Armit (1996, 109 – 158), Armit and Ralston (1997, 183 – 187), Parker Pearson and Sharples (1999, 1 –7) provide good summaries of current thinking on the subject. Hedges (1985, 150

- 175) summarises nineteenth century antiquarian activity in Orkney. Conducted without the scientific knowledge available to excavators today, these early investigations arguably raised more questions than they provided solutions. One consequence of this is the now largely discredited view, that the impressive monumental Atlantic roundhouses were built by immigrants from southern England (summarised in Mackie 1975, 27 – 29). Implicit in this theory is the assumption that when these innovators had left the islands their cultural influences degraded resulting in the less monumental structures such as duns and wheelhouses. Recent excavations in north Atlantic Scotland by the Callanish Archaeological Research Project (Harding and Armit 1990, Harding and Gilmour 2000, Harding and Dixon, 2000) and Sheffield Environmental and Archaeological Research Campaign in the Hebrides (Parker Pearson and Sharples 1999) have demonstrated an evolutionary sequence of structural type. They have shown that the archaeological evidence defies categorisation into typologies, and explanation by simplistic invasion hypotheses, and have thus opened the field to more constructive research objectives. It is becoming increasingly obvious that Atlantic Scotland was not peripheral and insignificant during prehistory and early historic times, but instead played key economic and cultural roles (Bond 1998, Harding and Gilmour 2000).

2.2.2 Comparative sites in the Northern Isles

In order to study more specifically the questions that can be addressed through the faunal analysis of cellular domestic structures of the Atlantic Late Iron Age, it is proposed to examine some recent work in the Northern Isles. Orkney and Shetland have benefited from several recent large-scale excavations, now published, which have employed modern scientific analytical techniques in the understanding of environmental remains. The general structural similarities between some of the buildings at these sites and those at Bostadh and Beirgh, together with the relative proximity of the Northern and Western Isles, to a seafaring people, makes their comparison a legitimate exercise. Orkney today may appear to be more green and fertile than Shetland and the Western Isles. This is partly due to its underlying sandstone geology, but much of this improved fertility is due to agricultural improvements in the last two centuries. Indeed the quality and quantity of arable land has greatly increased in Orkney since the end of the Second World War. It is therefore quite justified to assume that broadly similar environmental conditions prevailed on the Western and Northern Isles in the later first millennium AD, with perhaps minor climatic variations.

The archaeology of Late Iron Age Orkney and Shetland has been documented elsewhere (Fojut 1986, Fojut 1998, Hedges 1985, Ritchie 1985) so it is not proposed to cover it in any detail here. Complex Atlantic roundhouses, such as those at Gurness, Evie and Midhowe, Rousay, both in Orkney, are a striking feature of the landscapes of both Orkney and Shetland. Many have smaller, cellular and stalled buildings associated with them, which often post-date the complex Atlantic roundhouse and are generally built around the outside of the abandoned roundhouse, or into the rubble of the collapsed building. In this they differ from complex Atlantic roundhouses in the Western Isles which often stand on small islands in lochs (Harding and Gilmour 2000, 8). This obviously restricts the amount of space available for development outside the complex Atlantic roundhouse and subsequent structures are commonly built within the roundhouse itself as at Beirgh. When the complex Atlantic roundhouse is situated on "dry" land, such as machair, as is the case with Dun Vulan in South Uist, there are later buildings both inside and outside the original roundhouse structure (Parker Pearson and Sharples 1999, 345 – 347).

It is now proposed to examine briefly some of the sites in Orkney and Shetland that have been excavated and published, with a view to discussing the animal bone results and interpretations for the Late Iron Age occupation layers of the sites. Detailed structural reports will not be given, as they are available in the original publications. The interpretations discussed will be those of the original animal bone specialist and excavator, any re-interpretations by the present writer will be discussed below (Chapter 6).

Perhaps the nearest parallel to the Bostadh site in the Northern Isles is at Buckquoy, Birsay (Ritchie 1977) where indigenous, pre-Norse structures and Norse buildings were excavated in the early 1970's. The sea eroded a substantial part of the site but sufficient remained to suggest to the excavator that the Norse transition had been relatively smooth and had involved the integration of indigenous customs and cultures (Ritchie 1977).

There was "little difference in the animal bones between the Pictish and Norse periods" (Ritchie 1977, 191) with little variation in the relative proportions of the common domestic mammals represented in the two phases. The relative proportions of common domesticates indicated that almost half the assemblage was comprised of cattle, 30% sheep and 20% pigs, while other species comprised 5% or less (Noddle 1977, 208). It appears that the main economic use of the animals was for hides and meat, as one third died in the first year of life (Ritchie 1977, 191). Red deer were not mentioned in the text so they were presumably absent, or present in only negligible quantities. Little information about husbandry methods was presented in the report but it was surmised that since half the animals were kept for at least one winter there must have been sufficient fodder retained from the growing season to facilitate this. The pigs were small in comparison to modern breeds with "slender bones of the 'wild boar' type of animal" (Noddle 1977). Sheep bones suggested a type similar to wild (Mouflon) sheep, but Noddle suggests they were subjected to pressures which selected a type more like the Soay sheep of today. This happened later than expected with the more Soay-like bones being retrieved from what is described as topsoil, but is evidently believed to represent late Norse occupation. Bones from cattle indicate a type with a live weight of 180 – 200 kg (Noddle 1977, 208), around half modern size but bigger than those typical of the medieval period.

Fifty-four species of bird were retrieved the majority of which were wild species, as domestic geese and fowl were insignificant in the Norse period and Late Iron Age in Atlantic Scotland. Of the other possible species that might have been expected to appear in the bone assemblage from Buckquoy cat and dog bones were present in small quantities.

At Howe, near Stromness in Orkney, the "post-broch" buildings were built into the walls of the collapsed complex Atlantic roundhouse during Later Phase 7 and Phase 8 (Ballin Smith 1994). A complex series of buildings and courtyards, often modified or repaired, plus the possible existence of other, unexcavated contemporaneous structures (Shepherd 1994, 276) makes it hard to assess how many cellular structures were present in the Late Iron Age at Howe. However, their proximity to a complex Atlantic roundhouse, their cellular nature and the fact that a large assemblage of animal bone was collected and analysed from them make them useful *comparanda* for Bostadh and Beirgh.

Around 28,000 animal bone fragments were analysed from contexts dating from the Neolithic to the Late Iron Age (Smith et al. 1994) affording an opportunity to study continuity and change through time. The function of the site is believed to have changed over time, with the structures dating from the Neolithic possibly having a funerary, rather than domestic, role. Thus the reasons for animal bone deposition can be expected to have varied between possible symbolic deposition, which might reflect beliefs, to deposition of waste material which might reflect economic trends. In fact a negligible amount of identifiable animal bone was retrieved from the first three phases at Howe (Smith et al. 1994, 139, Table 11), so any such trends will not be discernible.

2.2.3 Western Isles

Armit observes that the Western Isles tend to be regarded as "the poor relations of the north" (Armit 1990a, 3) and the above hardly redresses this. Focussing on Orcadian sites is, however, a necessary consequence of the more readily available published material from sites in Orkney, that, itself is a result of concentrated archaeological activity in the islands throughout the 1970's and 1980's.

The relative lack of comparative published sites in the Western Isles serves to demonstrate the importance of Bostadh and Beirgh in the archaeological understanding of northern Atlantic Scotland in the first millennium AD. Little is known about the economy of the Western Isles at this time, due to a paucity of contemporaneous excavated, published sites.

Recent work on the complex Atlantic round house site of Dun Vulan in South Uist (Parker-Pearson and Sharples 1999) was published while the current research was in progress and provides useful comparative data. Another assemblage from later occupation layers at Beirgh has been studied (Cook 1997b) and will be commented on in Chapter 6.

The analysis of the faunal remains from Bostadh Beach and Loch na Beirgh allows the exploration of aspects of the economy and environment in the first millennia AD in the Bhaltos area of Lewis. Similarly, it facilitates comparison with the evidence that exists from elsewhere in Scotland (e.g. Ritchie 1977; Hunter et al. 1990; Ballin Smith 1994; Morris 1995; Dockrill 1998).

2.2 4 Bhaltos

The Bhaltos Peninsula is situated on the west coast of Lewis and contains many of the physical landscapes seen across Lewis and the Western Isles. The beaches of Traigh Clibhe and Traigh Cnip are characteristic of the small, sandy beaches found along most of the west coast of Lewis and the machair landscape of Traigh na Beirgh resembles the more continuous machair plain found further south in the Uists. The coastline is varied with sandy beaches, machair land, cliffs and low rocky platforms. Further inland the landscape comprises hills interspersed with small lochs, typical of many inland areas in the Western Isles. One landscape type that is not present on the Bhaltos peninsula is the blanket bog that dominates the interior of Lewis today. While the form of the Bhaltos landscape may have altered since the Iron Age the elements comprising it will have remained essentially unchanged. For example, the form and extent of Traigh Cnip and Traigh na Beirgh will have changed due to rising sea levels and the intrinsic dynamic nature of the machair system but both machair and shoreline environments will have been present in the Iron Age.

Archaeological features are prominent in the Bhaltos landscape today (see Figure 1.8) and range from large multi-period structures such as the complex Atlantic roundhouses at Bharabhat and Beirgh through to the small Norse milling platforms in the stream cascading down the hill from Loch Bharabhat. A short, steep, climb up the slope reveals Loch Bharabhat and the multi-phase complex Atlantic roundhouse that stands by its side. Parts of the complex Atlantic roundhouse can be seen still standing today, but the structural sequence includes some traces of Early Iron Age activity beneath it and Late Iron Age structures within and beside it. Excavations took place from 1986 – 89 (Harding and Dixon 2000) and focussed on the roundhouse and the adjacent structure most of which had collapsed into the loch, necessitating underwater excavation. It is believed (Harding and Dixon 2000) that the water levels in the loch were altered by the Norse to facilitate milling of grain on the drainage stream that runs down from the loch through the machair dunes into the sea. This was done by the construction of a dam at the top of the stream outflow that could be opened to increase water flow in the stream to operate the mills. Resulting higher water levels may have helped preserve the archaeological record at Dun Bharabhat, particularly the animal bone, since the only surviving bone material was retrieved from under the water, where preservation was so excellent that an almost complete mouse skeleton was retrieved (Dixon, pers com). Radiocarbon dating indicates occupation of the dun within the second half of the first millennium BC with secondary occupation dating from the 1st century BC.

Another area of archaeological importance is at Cnip where Bronze Age burials and cremations have been discovered (Armit 1996, 96 – 99) on the headland. Norse graves, with grave goods, are also present on the headland (Armit 1996, 197; Wellander et al. 1987) and nearby is the settlement site of Cnip Wheelhouse and later cellular buildings. The dating of the start of any architectural tradition will always be problematic, relying as it must on the interpretation of possible votive deposits or pit fills, any of which may post-date the construction of the building. The wheelhouse at Cnip is thought to have been built no later than the third century BC (Armit 1996, 146). A series of dates from Phase 2 of the occupation show that the wheelhouse had started to decline and was in need of rebuilding by the middle of the first century AD (Armit 1996, 146).

2.2.5 Loch na Beirgh

2.2.5.1 Introduction to the site and its surrounding environment

The site at Beirgh is a multi-phase site situated on an island in a loch in the Bhaltos peninsula of north-west Lewis. The surrounding machair plain, which lies behind the beach of Traigh na Beirgh, appears to have formed according to Ritchie's (1966) model B of machair development, involving continuing erosion of the beach front and subsequent deflation of the machair land behind the coastal dunes (Armit 1994, 72 – 3). The result was the infilling of Loch na Beirgh throughout the period of the occupation of the site and a concomitant rise in the water level of the loch. The rise in water level thus threatened to flood the occupation layers and consequently the floor levels had been built up, by partial levelling of previous structures and the infilling and raising of the floor surface (Harding and Gilmour 2000, 4). The result was a deep and complex stratigraphy that served to protect architectural structures remarkably well. The wet, anaerobic conditions in the earlier layers have resulted in particularly good organic preservation of wood and other palaeo-environmental data. The depth of the stratigraphy has been estimated at between three and four metres (Harding and Gilmour 2000, 5) and a sequence of 2.5 metres has already been excavated without yet reaching the occupation levels of the complex Atlantic roundhouse.

2.2.5.2 The occupational sequence

At the time of writing, the site appears as a complex Atlantic roundhouse, the ground floor levels of which have not yet been excavated. Due to the floor levels being below the current ground surface and the dampness of the surrounding ground further excavation will encounter particular difficulties and has been postponed. As further excavations will certainly reveal at least one more occupation layer the different structural phases have been numbered in reverse chronological order, i.e. the most recent one is Phase 1. Phase 12, the complex Atlantic roundhouse, is the earliest occupation phase revealed to date and is only partially excavated through investigation of the first floor intra-mural galleries (Harding and Gilmour 2000, 56). The assemblage studied in this research is from Phase 5, The Final Cellular Phase (Harding and Gilmour 2000, 25-31).

There are four principal phases of occupation at Beirgh; a Late Iron Age occupation phase with figure-of-eight buildings (Phases 1 to 4), the Middle Iron Age (Parker Pearson and Sharples 1999, 1) Cellular Phase (Phases 5 – 9), the Roundhouse Phase (Phase 10 – 11) and the Atlantic roundhouse occupation phase (Phase 12, see Figure 1.10). The structural sequence runs from the complex Atlantic roundhouse, followed by the construction of a substantial roundhouse within the structure's interior. There then appears a complex sequence of smaller cellular units, still within the broch interior that are replaced by 'figure-of-eight' buildings dating to the second half of the first millennium AD. The radiocarbon dates for the cellular occupation range from the 2nd to 5th century AD.

The complex Atlantic roundhouse has an overall diameter of around seventeen metres with walls averaging one metre thick at first floor lever and an intra-mural gallery of around a metre wide. Such dimensions make it the largest of the known Atlantic roundhouses in Lewis, although larger examples exist on Orkney, Skye and the Scottish mainland (Harding and Gilmour 2000, 56). The complex Atlantic roundhouse has at least seven intra-mural galleries at ground level, all but one surviving with capstones intact. The excellent anaerobic preservation conditions in these early levels provide what may be a unique opportunity in the archaeology of Atlantic Scotland to investigate the use of building materials such as timber, clay and peat, which do not normally survive.

Phase 11 largely consists of two wall features that stratigraphically post-date the Complex Atlantic roundhouse and pre-date the Roundhouse Phase.

Phase 10 is a Roundhouse built within the walls of the (presumably) partially demolished or ruined complex Atlantic roundhouse, using most of its internal floor space and intra-mural galleries. Full structural details of the Roundhouse await the results of further excavation and the structural data obtained to date is available in Harding and Gilmour (2000, 50-54). The Roundhouse probably lacked the upper floors of the complex Atlantic roundhouse but otherwise seems to have fulfilled a similar function (Harding and Gilmour 2000, 52-3). In contrast the subsequent buildings, constructed in a nucleated, cellular style may represent a change in the economic and social function of the site (Harding and Gilmour 2000, 53).

There are five cellular phases of occupation, phases 5 to 9, the Final, Late, Middle, Early and Primary Phases respectively (Harding and Gilmour 2000, 25 - 50). A black peaty floor deposit marks a clear horizon between the Roundhouse Phase and the Cellular phases. The Primary Cellular Phase (Phase 9) includes some structures that survive into the Early Cellular phase (Phase 8). The complex arrangements of cells, hearths and walls that make up the four phases prior to the Final Cellular Phase (Phase 5) are of limited interest and only the ones that survive into Phase 5 will be discussed. Full stratigraphical and structural details are available elsewhere (Harding and Gilmour 2000, 31-50).

Phase 5, the Final Cellular Phase (Harding and Gilmour 2000, 25-31) contained the "shamrock", a structure comprised of two connecting cells, Cells 1a and 1b, which open onto a forecourt to the south-west. Another conspicuous feature in this phase, one surviving from the previous phase, is the "souterrain" that occupied most of the south-eastern quadrant. The "souterrain" is a small passage-like structure, curved in plan, with a central drain and walls that combine upright slabs and dry-stone coursing. All the aforementioned features have parallels in the Scottish souterrain record. Only the uppermost of the three levels of paving perceptible in the passage and the drain date from Phase 5.

Two further cells, Cell 3 and Cell 4 are also occupied during this phase, both being simple U-shaped cells abutting the inner wall of the complex Atlantic roundhouse. Cell 3 abuts the west wall and access is from the south, through the courtyard next to Cells 1a and 1b. Cell 3 seems to have been occupied throughout the Late and Final Pictish phases (Harding and Gilmour 2000, 31). Cell 4 abuts the west wall of the complex Atlantic roundhouse with access presumed to be through the inner wall of the complex Atlantic roundhouse (Harding and Gilmour 2000, 31).

2.2.5.3 Chronology

Radiocarbon dates have been processed from the Secondary Roundhouse and Cellular phases. The dates were taken before 1995, when the current dating strategy had begun (see 1.1.6), so consisted of bulk charcoal dates and a bulk AMS date of barley grain. The charcoal derived from twigs and branches from fast-growing local species, retrieved from discrete charcoal concentrations sampled during excavation and the resulting chronology is coherent and is backed up by artefact dating (Church 2002, 62). The earliest date was derived from an occupation level on a floor of a first floor intramural chamber of the complex Atlantic roundhouse that was in use during the later roundhouse phase. The date calibrated to between the early second and the late fourth century cal AD. The other four dates calibrated to the early third to late 6^{th} century cal AD and were taken from secure contexts from the early to late Cellular phases (Church 2002, 62; Harding and Gilmour 2000, 63). The faunal assemblage used in this research derives from Phase 5, the Final Cellular phase which has been dated to 340 – 610 cal AD (Harding, 2000) at 95% confidence levels (2 σ).

2.2.6 Bostadh

2.2.6.1 Introduction to the site and its surrounding environment

Across the water from Bhaltos lies the island of Great Bernera, on the north-east of which is the site of Bostadh. Lying in a sheltered bay, surrounded by higher land the site is not inter-visible with the Bhaltos peninsula. The excavated part of the site comprises three figure of eight structures, their foundations dug into the sand, partly overlain by a rectilinear structure and a midden, both believed to be of Norse age. The phasing of this site is complicated by the fact that no inter-connecting stratigraphy could be determined between the three cellular structures, due to their foundations being within the sand dunes. Hence the phasing is largely based on structural and artefactual evidence, and for the purpose of this research four phases are recognised. Some problems were encountered in dividing the site into occupation phases as the phasing produced by the excavator was based on the construction of the buildings and some episodes termed phases, or sub-phases, represent, for example, the repair of a wall, an event which might have taken only a few hours. Such episodes had to be amalgamated to form phases that were more representative of the occupation of the buildings, which is when the environmental evidence might be expected to accumulate. Hence the phases described below will not tally exactly with those described by Neighbour (2001).

2.2.6.2 The occupation sequence

The settlement development has been divided into four broad occupation phases for the purposes of the analysis of the bones (Figure 1.2 and 1.3). Detailed descriptions of the stratigraphy of the site and of the construction of the houses are available elsewhere (Neighbour 2001; Neighbour and Crawford 2001, Neighbour and Crawford nd). A brief outline description of the structures in the various occupation phases as defined by the environmental archaeologists is given below.

Table 2.1 below shows an outline of the structural phasing.

Table 2.1: The structural chronology at Bostadh

STRUCTURES			PHASES
		A	4 (Norse)
		M	3 (Transition)
HOUSE 3(III)			2 (Ventral)
HOUSE 3 (II)			
		HOUSE 1	
		HOUSE 2	
HOUSE 3 (I)			
H	P		1 (Early)
J	Q		

Adapted from Neighbour (2001, 10)

Phase 1 - Early

Phase 1 has been divided into two blocks between which there are neither stratigraphic connections nor any evidence for their relative age. There are four ephemeral early structures, Structures P, Q, H and J. All were largely eroded away, or had been incorporated into later building work. Structures P and Q formed part of House 4 while Structures H and J were subsequently incorporated into House 3

House 4

Structures P and Q were the most deeply buried on the site and were part of a fourth house which was only partially excavated due to being located next to the section edge on which the spoil heap was located, meaning that only keyhole excavation could be carried out for safety reasons. The earliest artefacts produced from the excavation came from Structures P and Q. The two structures were separated by a layer of wind blown sand of about 0.5 m depth and Structure Q lay beneath Structure P. Structure P (Figures 2.1 and 2.2) seems to have still been in use when House 3 was occupied, falling out of use when repairs were made to the eastern wall of House 3 (Neighbour 2001, 10).

Other structures

Structure J was a small cell later incorporated into a linear structure similar to that found at Cnip wheelhouse Phase 3 (see Figure 1.2). While the dimensions of Structure J would certainly allow for it having been a bay in a former wheelhouse that had been substantially altered there was insufficient evidence remaining to confirm this hypothesis (Neighbour 2001, 9).

Structure H (Figure 2.3) was the "ghost" of a rectilinear structure similar to Cnip Phase 3 and appeared to have been substantially altered during the building of House 3. A "petal-shaped" hearth under the north-eastern wall has parallels at Beirgh and Jarlshof (Neighbour 2001, 10).

Other sediments which may be considered to have accumulated in Phase 1 are the sand layers between the walls of the figure of eight houses which may contain bones and other ecofacts deposited as middens around the early structures then incorporated into the sand layers that were dug through during the original construction of the double walled figure of eight houses (see below).

Phase 2 - ventral

Phase 2 consisted of three "figure-of-eight" houses, or "ventral" buildings (Neighbour 2001), revetted into the sand. The fact the buildings were effectively dug into the sand dunes served to preserve them well, often the full height of the walls remained (Church 2002, 65) but it also created problems in interpretation as there was very little interconnecting stratigraphy between the three structures. The artefact assemblages from the three structures are similar (Neighbour, pers. comm.) and the assumption is made that they were broadly contemporaneous.

The earliest structure in this phase was House 3(I), illustrated in Figure 1.3 which predated Houses 1 and 2 on stratigraphic grounds. Alterations were made to the eastern wall of House 3 (House 3(II)) after the construction of Houses 1 and 2. House 3 appears to have been occupied for longer than Houses 1 and 2 (Neighbour 2001, 11). A stratigraphic link in the form of a small section of wall, demonstrated that House 2 predated House 1 in its construction.

House 3 (II) had repairs done to its eastern wall at some time after the construction of House 2 and possibly House 1 (Context 65 in Figure 2.6). An outer wall skin was added, sitting over the outer face of House 4 and this may indicate the abandonment of House 4 (Neighbour 2001, 11).

House 3 (III)

A further repair was carried out on the eastern outer wall skin of House 3 involving the digging of a small trench and the rebuilding of some stonework. (Context 773 on Figure 2.6) This repair was of poorer quality than the original wall (Neighbour 2001, 12).

The pre-floor pits and occupation deposits from House 1 are shown on Figures 2.7 and 2.8 respectively.

Phase 3 - transitional

The second phase of occupation was followed by a period of abandonment in which wind blown sand and rubble accumulated and all three figure of eight houses are believed to have filled in, suggesting at least part of the site had been abandoned for an unknown period of time (Church 2002, 65). A small structure within one of the buildings (Structure M, within House 1) together with rubble accumulation within House 1, and midden deposits all over the site, are features believed to date from Phase 3. They are considered to represent occasional use of the site during the transition from Late Iron Age to Norse occupation (Church 2002, 65). The construction and use of Structure M has been termed "squatter activity" by the excavator, to indicate its presumed transience. Abandonment features in House 2 are shown in Figures 2.9 and 2.10, while Structure M in House 1 is shown in Figures 2.11 and 2.12.

Phase 4 - Norse

Phase 4 represents the Norse occupation of the site when they appear to have achieved cultural hegemony over indigenous traditions of building and artefact manufacture. Features of interest within Phase 4 include a rectilinear building and extensive midden deposits up to 0.3m deep in places. The rectilinear building contained a single floor level and no other surviving deposits or features, and low wall footings of only a couple of courses in places, suggesting the building may have been mostly of turf (Church 2002, 65). The part of the rectilinear building that was excavated is depicted in Figure 2.13.

2.2.6.3 Chronology

Phase 1, the earliest structures, resemble Cellular structures at Loch na Beirgh and Cnip (ranging from the first to sixth centuries cal AD). Twenty eight AMS dates from Phases 2 through to 4 are shown in Figure 1.7, and all fall within 700 to 1000 cal AD at 95% confidence levels (Church 2002, 66). There is a radiocarbon plateau within this period, between 780 and 900 cal AD, which has prevented detailed resolution between the different phases, but the dating programme did confirm that the main foundation and occupation phases of the three "figure-of-eight" buildings were contemporaneous (Church 2002, 66). All radiocarbon dates are given at 95% confidence intervals, or 2 σ.

The dating chronology at Bostadh covers the important transition period between the Late Iron Age and Norse occupation, so the bones from each phase were analysed separately despite the small sizes of the assemblages. It was felt that analysing phases together would mask any differences in the assemblages that might reflect cultural change. The settling of the Norse in Atlantic Scotland is widely recognised as an important cultural watershed (e.g. Barrett et al. 2000); a time of social, political and economic change. It was therefore thought to be important not to miss any economic change that might be apparent within the bone assemblages from the Norse occupation phases. Zooarchaeological evidence for a change in food procurement in the Late Iron Age / Norse transition period has been discovered in the Northern Isles (Barrett et al. 1999).

Table 2.2: The chronology of Bostadh and Beirgh

Structure and occupation phase	**Dating based on:**	**date**
Bostadh Phase 4	Cereal caryopsis – ^{14}C	700 – 1000 cal AD
Bostadh Phase 3	Cereal caryopsis – ^{14}C	700 – 1000 cal AD
Bostadh Phase 2	Cereal caryopsis – ^{14}C	700 – 1000 cal AD
Bostadh Phase 1	Structural typology	First to sixth century AD
Beirgh Phase 5	Wood charcoal – ^{14}C	340 – 610 cal AD

2.3 Conclusion

The natural environment of the Western Isles has been described as it exists today and as it is believed to have existed in the Iron Age as far as can be interpreted from environmental evidence. The geology and topography have been described and the effects of the climate, in particular the weather systems that are a vivid feature of the islands today, considered in terms of their implications for the prehistory of west Lewis. Geology, topography and climate impinge upon the vegetation of an area; so the prehistoric vegetation evidence, mainly gleaned from palynological studies, was considered in order to build up a picture of the resource base available to humans and animals in west Lewis and Bernera in the Iron Age.

The human environment of the Western Isles in the Iron Age has been discussed with emphasis on the importance of the north Atlantic province. Some reasons why archaeology is such a prominent feature in the province are examined and the recent thinking on the Iron Age in north Atlantic Scotland is summarised, stressing the evolutionary nature of the architectural forms and the non-peripheral nature of the area. The peninsula of Bhaltos on which the sites of Beirgh and Cnip are located is described. The two sites from which bone assemblages are being studied for this research are then outlined and the occupation phases and chronology detailed.

Chapter 3: Methodology: theory and practice in zooarchaeology

3.0 Introduction

Zooarchaeological analysis can be approached from a number of different theoretical and methodological viewpoints. It is hoped to illustrate here that the study of taphonomy is the key to successful analysis of zooarchaeological material and will be an essential consideration in the study of the animal bones from the sites of Bostadh and Beirgh. The first part of this chapter discusses the important contribution that an understanding of taphonomy makes to a full comprehension of the significance of a zooarchaeological assemblage. Taphonomic processes are divided into two types, those outwith the control of the archaeologist, and those which can be influenced by archaeological decision-making. The factors that cannot be controlled by the archaeologist are discussed first, as it is important to appreciate the processes acting on the living animals on and around the site that determine what faunal material exists within the soil at the time of excavation. The second order of taphonomic processes is under the control of the archaeologist, and in the case of this study many were within the control of the author. Hence these second order changes are the concern of the remainder of the first part of the chapter which examines the theoretical background behind various retrieval and post-excavation techniques used in archaeology at the present time.

The second part of the chapter details the methodology used in this study as the post-excavation analysis is also an important taphonomic process. Because of the tremendous variety in faunal assemblages and, therefore, in the research questions that they may address, there has been little success in attempts to establish a universally accepted methodology among faunal workers. Due to this lack of standardised, universally accepted procedures it is necessary that precise details of the techniques used in faunal analysis are explained clearly and the second part of this chapter aims to provide this information.

3.1 Theoretical background for methods used

3.1.1 Taphonomy

Death of any living thing initiates a natural sequence of events that terminate in chemical recycling, or, much more rarely, in fossilisation, the conversion of organic matter to mineral. In the vast majority of cases an animal or plant will be consumed or decompose on or near the ground surface, with the decomposition involving a number of biological and chemical agents and the time taken for the various decomposition processes varying according to the surrounding environmental conditions. Archaeological excavation will sometimes interrupt decomposition, revealing partially preserved organic material (Dincauze 2000, 423). Sometimes this material will be partially or wholly mineralised as a result of natural or cultural processes. The organic component of plant or animal remains may be preserved in particular environments, such as anaerobic conditions. Any preserved material discovered during excavation indicates that unusual circumstances have interrupted the natural decay processes.

It can be appreciated that the study of the sequence of events that lead to animal remains being included in the archaeological record will be of interest and importance to zooarchaeology. These sequential events, or processes, include the circumstances that lead to an animal being in the environment in which it died, the surface processes that modify the skeleton (both natural and cultural), the burial and decomposition processes as well as the excavation and analytical procedures used. The study of these processes is called 'taphonomy', derived from the Greek *taphē* (burial), coined in 1940 by Efremov, a palaeontologist, as a means of defining the study of the processes by which living animals become part of the fossil record. The aim of 'this branch of science is the study of the transition (in all its details) of animal remains from the biosphere to the lithosphere' (Efremov 1940, 85; cited in O'Connor 2000, 19, insertion in the original).

Taphonomy as it applies to zooarchaeology has been of academic interest since the 1970s (e.g. Andrews and Evans 1983, Binford 1978, Brain 1981, Gautier 1987, Hesse and Waspnish 1985, Meadow 1980). Excellent summaries of the history and nature of taphonomic research exist (e.g. Lyman 1994, 1 – 40; O'Connor 2000, 19 – 27; Reitz and Wing 1999, 110 - 141) so it is not intended to attempt to repeat these here. Instead, the main taphonomic processes will be reviewed, giving some zooarchaeological examples and paying particular attention to how the taphonomic processes might be manifesting themselves in the assemblages under study.

Zooarchaeologists have certain advantages over other specialists in that they have a model to work from; the number, appearance and arrangement of bones in living mammalian skeletons are known. The reasons for the difference between the model and the retrieved assemblage can be explained through taphonomic analysis (Lyman 1994, 97). Perhaps because of this, zooarchaeologists in general, are well aware of the importance of taphonomy in the study of faunal assemblages (*e.g.* Andrews 1995; Davis 1987; Gautier 1987; Halstead 1987; Lyman 1994; Maltby 1985; Meadow 1980; O'Connor 2000; Payne 1972, 1975, 1985b; Reitz and Wing 1999).

It is often implicitly assumed that the material recovered in an excavation represents most of the material deposited during the period of interest, and further, that the deposited material is a direct reflection of the human exploitation of the environment (Meadow 1980, 65). In fact, both these assumptions are wrong in most circumstances. Material of all kinds is lost from, and added to, the assemblage at several stages between initial deposition and excavation. The deposited material may, in itself, represent a minor fraction of the material originally present on the site.

In the case of faunal remains this may perhaps be best illustrated schematically (Fig 3.1) and numerous authors have produced pictorial models to this end (Meadow 1980, 67; Davis 1987, 22; Lyman 1994, 24, based on Medlock1975; Reitz and Wing 1999, 111). The models portray the processes acting on the originally deposited material which result in a 'decline in the integrity of the information' (Reitz and Wing 1999, 110). These processes can be divided into two main groups, those that can be controlled by the archaeologist, and those that cannot.

The following paragraphs may create the impression that all the listed taphonomic processes will act upon every bone, or even that they will act on a bone in the order in which they are described below. This is not the case; some bones may not experience some taphonomic processes, while some will experience repeated exposure to one or two processes during their taphonomic history.

3.1.1.1 Processes which cannot be controlled by the archaeologist

The processes outwith the control of the archaeologist start with the biotic processes that influence the numbers and types of animal species at and around a site at any particular time (O'Connor 2000, 20). Biotic processes take both natural and cultural forms and include phenomena such as climate, season, vegetation range, biogeography and ecology as well as human behaviour, such as livestock domestication and the choice of hunting and foraging areas exploited. Biotic factors establish "the character and magnitude of the environment exploited, the species available and their abundances...and the species perceived as useful" in the past (Hesse and Waspnish 1985, 20).

On Lewis the relative isolation of the island since the last glaciation has led to a restricted range of fauna and flora species present on the archipelago and both vegetation and climate select for small, hardy variants of sheep, deer, cattle and ponies. However, the coastal location of both Beirgh and Bostadh afford valuable opportunities for exploitation of the much more varied and abundant marine species from whales to limpets.

Thanatic processes result in the death and initial deposition of the animal and include natural death through disease, accident, age and cultural practices that determine selection of animals for slaughter and how the carcass is butchered (O'Connor 2000, 20). Thanatic processes often reflect human decision-making and are therefore of particular archaeological interest. Human cultural taboos and dietary preferences have a considerable influence on the bones that will be deposited on a site (Payne 1985b, 212). Thanatic processes include the behaviour of other carnivores such as dogs, hyenas, bears and birds of prey (Davis 1987, 24; O'Connor 2000, 66) that can accumulate deposits of animal bone themselves (Bramwell et al. 1984) or add or subtract from the products of human deposition. Predators modify bone assemblages by selecting prey, breaking bones, dispersing body parts and digesting some of the smaller elements (Andrews 1995, 147; Hockett 1996).

At Bostadh and Beirgh some probable thanatic processes include the selection of animals, and their products, whether from domestic stock or gathered / hunted from the surrounding environment.

The combination of biotic and thanatic processes ensures that there will almost never be a direct correspondence between the life assemblage and the death assemblage. A possible exception is catastrophic kill sites, such as North American bison kill sites (Meadow 1980, 66) and natural disasters like floods, droughts and volcanic eruptions (Lyman 1994, 118).

The effect of biotic and thanatic processes has important zooarchaeological implications. As an example, the reproduction rate of a species (a biotic process) will affect the quantities of that species present on site, thereby affecting the number of animals available for slaughter (a thanatic process). Maintenance of two equally numbered herds of domestic animals with different breeding rates, e.g. pigs and cattle, will allow many more of the large-littered, quick breeding animals (pigs) to be killed than cattle, while still maintaining herd numbers (Meadow 1980, 66). Thus the archaeological record would show that several times more pigs were slaughtered than cattle. Without an understanding of ecological (biotic) factors such as the breeding rates and life span of these species it would be tempting to misinterpret the evidence as suggesting that more pigs than cattle were generally present on site. Hence 'no one to one relationship can be drawn between the relative number of bones and the relative number of forms kept by a stock breeding people' (Meadow 1980, 66).

Perthotaxic processes act to "destroy animal corpses within any particular environment" (Clark et al. 1967, 155) before their final incorporation into the burial matrix (O'Connor 2000, 20). These processes, leading to 'secondary disposal' (Meadow 1980, 66), include human processes, such as relocation of waste material in activities such as floor sweeping (Meadow 1980, 66), hearth emptying and midden spreading. Perthotaxic processes carried out by other animals include the actions of scavengers, including dogs, pigs and commensals, adding and removing faunal material from site dumps. Commensals are animals which live (and die) alongside people, consuming the same food and possibly adding their carcasses to a site assemblage without having themselves been consumed by humans (Reitz and Wing 1999, 117). Rats, toads and snails would be examples of commensals in Britain today, but may form part of the human food chain in societies distanced in space or time from our own. Non-biological perthotaxic processes include movement and modification by wind and water. Alternate wetting and drying, or freezing and thawing, can destroy bone before it is buried. Running water and wind-blown sand may erode bones, rendering them unidentifiable and masking any surface modifications.

In the following case studies, examples of perthotaxic processes might include deposition of materials in middens and pits, as well as keeping floors clear of debris.

Once the faunal material is incorporated into the burial matrix it is acted upon by taphic processes. These include the physical and chemical reactions which take place within the soil or sand in which the bone lies (O'Connor 2000, 20) and the "when, where, how and why of burial" (Lyman 1994, 514). Percolating groundwater, chemical soil conditions and human and natural forces of erosion are taphic processes (Payne 1985b) as is chemical bonding with metals such as copper and iron pyrites (O'Connor 2000, 21) and leaching of minerals from the bone. Examples of biological taphic processes might include trampling by humans and animals and disturbance by burrowing animals such as rabbits, moles and earthworms. Other zooarchaeologically important taphic processes are the destruction of the organic component of bone through biological (microbial) action and chemical reactions in the burial matrix.

Taphic factors at Bostadh and Beirgh include the chemical preservation of the animal bones and marine shells in the sandy machair soils of the region.

The final set of processes which cannot be controlled by the archaeologist are known as anataxic processes and are essentially "recycling forces", acting on re-exposed bones (O'Connor 2000, 20). Their effects are distinguishable from perthotaxic processes because the chemical and physical nature of the bone has changed after burial in the soil (O'Connor 2000, 20). Taphic alteration may have left the bone more mineral-rich than it was immediately after death, which may render it more susceptible to physical abrasion or to shattering under pressure than when fresh.

An example of commonly seen around Atlantic Scotland is the erosion of ancient bone material out of midden deposits into the sea. Exposure and subsequent erosion of bones by wind-blown sand is another example of anataxic processes operating around Bostadh and Beirgh.

3.1.1.2 Processes controllable by the archaeologist

The second order of taphonomic processes is within the control of the archaeologist and consists of sullegic and trephic processes. Often not recognised as taphonomic processes, or sometimes referred to as retrieval taphonomy, **sullegic** processes are the archaeological activities and decisions that influence the quality and quantity of data retrieved in an excavation (O'Connor 2000, 20). The act of excavation involves constant decision-making about where and how to excavate and how, where and when to sample, all of which have a great influence on whether any particular bone fragment will be retrieved (Reitz and Wing 1999, 113). It is now widely recognised that sieving is hugely influential in determining which species and body parts are present in an assemblage (Payne 1972, 1975; Reitz and Wing 1999, 120), and this will be expanded upon below (3.1.2).

The land under immediate threat from marine erosion determined the choice of excavation area at Bostadh, while at Beirgh the surrounding topography and the research interests of the archaeologists excavating the site influenced the choice of excavation area. Although the present writer was not involved at the planning or excavation stage at either site other environmental specialists were present and have had some influence on sampling strategy (Church 2002).

Trephic processes are the final set of taphonomic processes, and are, largely, under the control of the particular archaeologist(s) conducting the post-excavation research. Trephic processes include decisions about how to sort and categorise excavated materials, how and what to catalogue, the level to which a specimen should be identified and recorded and decisions on what and where to publish. It is important that this level of research is recognised as taphonomy as it can greatly affect the information produced from any site (O'Connor 2000, 20).

As the first order taphonomic processes have already acted upon the material retrieved in the assemblage there is little else to be said about them, other than to recognise their effects. Of the second order processes, the sullegic processes; the excavation, sampling and processing decisions and activities had already taken place when the current writer became involved in the project. The remainder of the first part of this chapter is concerned with the theoretical arguments behind the excavation and post-excavation stages in the archaeological process, i.e. the sullegic and trephic processes. Section 3.2 details the methodology employed on the project, both before and after the involvement of the current writer in the zooarchaeological analysis.

3.1.2 Retrieval and sampling

Sampling is part of a larger field of study called inductive inference, which can be defined as 'an attempt to draw conclusions about the general from information about the specific' (Orton 2000, 17). Although collections of skeletal material from excavations are often regarded as representative samples of populations once living on the site this will rarely be the case, as has been argued above.

All excavations have physical limits and boundaries that are unlikely to correspond with the physical boundaries of the site investigated and even less likely to correspond with activity areas surrounding the site. It will therefore never be possible to retrieve the entire deposited assemblage so any excavation is already sampling the original population, even if every artefact and ecofact excavated could be retained. Likewise the degree of recovery undertaken, whether or not sediments are sieved or screened, has a huge effect on how representative the sample will be.

Excavation methodology has considerable impact on the type, quality and quantity of bones collected. Removal of large quantities of soil by mechanical digger will result in the majority of bones being missed, as they will be incorporated in the large chunks of extracted sediment matrix. Similarly, removal of deposits by picks, shovels and mattocks will risk the loss of bone material. Time and cost limitations obviously affect the method of excavation chosen. Although such large scale earth removal techniques seem bound to result in poor bone retrieval the methodical removal of sediment from a trench by trowel need not necessarily be much more effective. Small bones in particular may easily be missed during hand collection, resulting in a sample lacking the smaller bones of larger species and almost all bones of smaller species (Payne 1972; 1975; 1985b). Hand collection also lacks consistency, with excavators varying in their ability to notice and retrieve bone. Even the same excavator's ability may vary from day to day depending on weather conditions as well as on personal factors such as concentration, motivation and physical health. It can be anticipated, therefore, that a deposit "sampled" by hand-retrieval by several people may be treated differently by each person, resulting in many different assemblages being retrieved (O'Connor 2000, 31). Many of these problems can be avoided by sieving the material excavated. This serves to break down the sediment and 'catches' small bones overlooked in the trench. The resulting sample of bones is more representative of the original deposited population as it contains more of the smaller bones (Payne 1972, 1975). The choice of mesh size will be determined by the research aims considered within constraints imposed by time and finance.

As it is not normally economically feasible to sieve all excavated deposits through a mesh, further sampling must be undertaken. Sampling methods vary according to the research aims of the project and it is important that sampling strategy be considered at the research design stage since the zooarchaeological research questions that can be addressed are highly dependent on the retrieval methods used. Consistency is important in retrieval of faunal remains if any meaningful quantitative studies are to be conducted on the material collected (Reitz and Wing 1999, 145). A rigorous sampling strategy is, therefore, important so an attempt should be made to use the same method of bone extraction from all deposits excavated.

While the ideal sampling strategy might include the presence on site of various environmental archaeologists with the equipment and time to subsample each deposit context excavated, the reality is likely to be radically different as time and cost restrictions impinge hugely on sampling strategies employed. In many excavations in Britain today a routine sampling strategy is employed, involving the removal of a sample of each excavated deposit (total sampling) or of selected deposits (judgement sampling) for processing. Occasionally, 'special' samples will be collected for processing in the laboratory for the removal of insect remains, or pollen or because a deposit contains a rich sample of a particular material such as charred grain, charcoal or waterlogged plant remains.

The flotation machine used in processing routine samples is described in Appendix 3.1. Again, decisions must be made in the research design stage as to what size of mesh should be used, as this will affect the material retrieved. For example, a 10mm gauge will allow quick processing of the material excavated but will miss many fish bones and land snails present on the site, thereby preventing certain cultural and environmental questions being asked of the faunal assemblage. Reitz and Wing (1999, 120 - 121, Figure 5.2) provide an example of the importance of mesh size in zooarchaeological interpretation. A site called Kings Bay in Georgia in the USA produced a large amount of fish vertebral centra, the vast majority of which were smaller than the 6.5 mm mesh used to screen (dry sieve) the sediments. These vertebral centra would have been missed had flotation not been carried out, resulting in the evidence for the exploitation of very small fish being missed. This, in turn, would result in loss of information about thanatic processes of prime archaeological interest, i.e. the trapping of small fish with the use of a fine gauge net, scoop or trap.

The removal of a sample of excavated deposit for processing has implications for the interpretation of the environmental data retrieved. As the original size of the entire deposit is not generally known it is not possible to extrapolate the quantities of smaller material retrieved to facilitate comparison with (larger) ecofactual data obtained by other methods, such as excavation in the trench. For this and other taphonomic reasons the relative importance of larger mammals, fish and grain in the palaeodiet cannot be determined by the archaeological methods usually employed in Britain at the present time. Other methods of investigation, such as stable isotope analysis, are necessary if one is to ascertain the relative importance of, for example, terrestrial animals, marine animals and plant material in the palaeodiet (e.g. Barrett et al. 2001; Bonsall et al. 2000; Burton and Price 1999; Richards 2000a, 2000b; Neighbour and Montgomery forth.; Montgomery et al. forth.).

3.1.3 Identification

Identification in zooarchaeology is the process of comparing a specimen from an unknown animal with bones from animals of known species in order to arrive at the most likely taxonomic category from which the specimen may have been derived. It is not an exact science and the results could be argued to be closer to statistical probabilities than facts.

The animal species from which an archaeological specimen derived can never be empirically proven, yet it is on these identifications that the entire animal bone report rests. Archaeological specimens are compared to modern reference material; therefore the process is strongly dependent on the principle of uniformitarianism. For example, it is assumed that, with allowances for increases in size and stature among known domesticates, sheep bones from the past bear a closer resemblance to modern sheep bones than they do to, for example, modern roe deer or goat bones. This process becomes increasingly less reliable as the animal assemblages become increasingly distanced from us in time (Davis 1984, 32). The zooarchaeologist arrives at an attribution, rather than an identification (O'Connor 2000, 39), and may conclude 'I attribute this bone to sheep', it being more likely to have derived from sheep than from any other taxon. This state of affairs can lead to debate on the relevance of the zooarchaeological use of the Latin binomials (O'Connor 2000. 40) devised by the International Code of Zoological Nomenclature (ICZN; Driver 1992, 38). If the identification process is really an attempt to discover from which taxon a specimen has the greatest probability of deriving, then labelling the specimen '*Ovis aries* L.' may appear like an attempt to cloak zoological uncertainty in a scientific mantle. However, the need to avoid dialectal and linguistic confusion and ambiguity strongly favours the use of Latin binomials in zooarchaeology, with the proviso that zooarchaeological methodologies compromise them (O'Connor 2000, 40). As the Latin binomials are an artificial device used for classification, similar to archaeological typologies for ceramic or lithic material, it is perfectly acceptable to develop other methods of classifying animals in zooarchaeology (Driver 1992, 38). These may be based on size (e.g. "large mammal"), taxonomic order (e.g. "artiodactyl") or diet ("carnivore"). Such categories provide a more generalised classification scheme than that defined by the ICZN (International Code of Zoological Nomenclature) and are useful in that they allow more of the assemblage to be included in the analysis than if only those specimens identified to species are recorded (Driver 1992, 38). If the analysis is to be fully understood and used by other workers it is essential that the identification methods are explained fully, and, ideally, some idea of the nature and quality of the reference material is given. The required brevity of the majority of faunal reports generally excludes such information.

Identification methods vary between workers, and the ability to identify any particular specimen varies according to the experience of the worker, and the quality of the reference material available to them. As most archaeological investigation is concerned with biotic and thanatic processes it is generally seen as desirable to identify a specimen to species level. If later taphonomic processes were of prime interest this would be less necessary (O'Connor 2000, 36). Perthotaxic, taphic and anataxic processes could be examined by assessing the degree to which the fragments were abraded or mineralised, in which case using only the taxonomically identifiable fragments would risk biasing the sample towards what may well be the less abraded (and more identifiable) fragments.

Unspoken assumptions are made during the identification process (Driver 1992). Perhaps the biggest assumption is of the range of possible taxa from which a specimen may derive (Driver 1992, O'Connor 2000, 37). A worker dealing with Scottish material, when confronted with a fragment believed to derive from a small ruminant will believe it to be from a sheep, a goat or a roe deer. It is unlikely that s/he will consider the ibex or gazelle as possibilities in normal circumstances. Exotic species do occur, but they are probably identified as a result of a combination of circumstances, triggered by a 'poor fit' between the unknown bone and all the most likely reference taxa, and possibly encouraged by other evidence of trading or other contact with distant places. Previously held information can influence future conclusions, particularly in the case of biogeography, when introduction dates, and extinction dates, of animal species are believed to be known. A vivid childhood memory of being taken on a grey, rainy January day, to see a live flamingo (*Phoenicopteridae* sp) in a loch near Kirkwall, Orkney (Groundwater 1974, 64), serves to remind this writer that such biogeographic assumptions are more easily made with mammals than with birds or fish. Arguably the increased confidence with which identifications / attributions can be made to species level with mammals, while often only to family or order level with birds and fish, is in some way due to this lesser mobility of mammals relative to fish and birds.

Identification normally proceeds by identifying from which element the specimen derives then allocating it to a species, where possible, or a range of species (Reitz and Wing 1999, 153). A fragment of humerus may be identifiable only as being from a "large mammal" and knowledge of the biogeography of the area would have to influence the range of possible large mammals. In Britain these might include horse, cattle, human, small whale and red deer. In some cases the bone would be obviously artiodactyl, limiting the range to red deer and cattle. In British zooarchaeology the most notorious problem in this respect is the differentiation between the small bovids (sub-family *Caprinae*), sheep and goats, which is possible only on a limited range of morphological and metrical criteria (Boessneck 1969).

3.1.4 Recording

Data obtained from the archaeological specimens should be recorded as fully as possible and a detailed key to any abbreviations used should be supplied. Ideally, it should be possible for another worker to analyse the raw data without having to return to the archaeological material. Consistency is important when recording information from archaeological specimens and an examination routine should be established and adhered to, with every effort being made to record the same features, in the same way, from every specimen.

3.1.5 Taphonomic markers

3.1.5.1 Butchery

One of the main taphonomic markers that may be present on a specimen is indication of butchery. Different types of butchering activity leave different marks on a bone (Binford, 1981) and the examination of these, together with the fracture patterns of bones, should allow certain conclusions to be drawn about butchery practice. To an extent the study of butchery marks will be guided by the research design, and might encompass examining the bone fragmentation to discover whether most material was chopped into pieces suited to the cooking pot, or alternatively, whether the relative completeness of the bones indicated the roasting of almost complete carcasses. However, fragmentation may be caused by factors other than butchery so it is rather complex to analyse (Reitz and Wing 1999, 157).

Another taphonomic indicator that commonly occurs on bones is evidence of burning. Bones may be burnt during the cooking process, or they may be put on the fire as fuel after consumption of the meat.

3.1.5.2 Burning

Burning may alter bone in several ways affected by many things including variations in temperature and oxygen within the fire, and fat content and density of the bone. A recent study on how these and other variables affect the surface morphology of burnt bone (Nicholson 1993), showed little observable correlation between burning temperature and colour, and concluded that attempting to deduce the temperature at which a bone fragment had been burnt was of little archaeological use. This is due to a number of reasons, not least because of the variation in temperatures within a fire, which imply that even if the burning temperature of the bone was known it would be little help in knowing what sort of fire caused it (Nicholson 1993, 427). Therefore it can be argued that presence / absence is the most useful thing that can be noted about burning on a bone.

While some work has been carried out studying how burning alters the surface morphology of a bone (e.g. Shipman et al. 1984, Nicholson 1993), little appears to have been done on how burning affects the preservation of bone. In general, burning destroys the organic component (collagen) from the bone with a concomitant proportional increase in inorganic material resulting in the bone becoming brittle (Lyman 1994, 389). While the resulting bone fragments are likely to break up into small, unidentifiable pieces something in the burning process appears to render the burnt material more resilient to some soil conditions (Nicholson 1993, 411). For example, often the only faunal material retrieved from excavation in Scotland is burnt, calcined bone (e.g. Thoms 2002, Thoms forthcoming a; Thoms 2003b). Combustion appears to aid preservation of bone by destroying much of the organic constituent that might otherwise be destroyed by microbial action. The chemical changes that are effected by burning are varied and complex and our understanding of them incomplete (O'Connor 2000, 45), but it is possible that the more highly inorganic material has a greater resistance to the mildly acidic soils that characterise much of Scotland away from the coastline. Lyman (1984, 391) argues that there is a widespread belief that the reason for the perceived greater resilience of burnt bone is that the bones consist mainly of carbon, an inert chemical. He goes on to refute this with the results of a series of (unfortunately unpublished) experiments on the comparative survival of burnt and fresh bone in solutions of pH 3 and pH 6 (Knight 1985, cited in Lyman 1994, 389 – 391). Obviously one cannot infer from such empirical evidence that burnt bone will always react more strongly to acidic conditions, since factors such as moisture level, the presence of other chemicals (e.g. fat) and the surrounding temperature strongly affect the rate at which chemical reactions progress.

3.1.5.3 Gnawing

Larger carnivorous mammals, such as dogs and foxes, are highly destructive of animal bone and tend to render any bones that are not completely destroyed into an unidentifiable state (Payne and Munson 1985, Stallibrass 1990). The amount of damage inflicted on a bone will vary according to the relative size of the bone and the consumer. Smaller carnivores are likely to inflict less damage on larger bones (Moran and O'Connor 1992). Occasional identifiable fragments do survive and their presence indicates the presence of carnivores on and around the site as well as suggesting that the bones may have been lying around in an uncovered state for some time prior to burial. Once again, presence / absence is all that need be noted. Bones may show indications of having been gnawed by rats or other rodents suggesting the context from which they were retrieved may have been disturbed, or that the bones may have been left exposed for some time before being incorporated in the burial matrix.

3.1.6 Age at death

Three methods of assessing the age at death of an animal are used in zooarchaeology. They are based on the ontological study of mammalian skeletons, the fact the skeleton changes in predictable ways over the life of any individual animal and on the assumption that these changes occur at broadly the same time for all animals of any given species.

3.1.6.1 Epiphyseal fusion

One method of assessing age at death is based on epiphyseal fusion. In the developing foetus the skeleton is largely comprised of cartilage and the sequence in which it converts into mineralised bone material follows a pattern, consistent for each skeletal element and for each species, with growth occurring at both epiphyses and also on the diaphysis of the bone. When growth is complete these three growth areas meet and the cartilage between them ossifies completely. Details of this process are available elsewhere (e.g. Davis 1987, 50; Lyman 1994, 70). Investigation of the ages at which each skeletal element fuses in modern mammals has led to the development of tables of fusion ages, which can then be applied to archaeological material, one of the most commonly used is by Silver (1969).

The age at which epiphyseal fusion occurs is generally given as a range (e.g. 6 – 10 months) rather than an exact age, because fusion takes some time to complete. Furthermore, fusion age is not constant for all animals of a given taxon, being influenced by state of health, nutrition and sex of the animal (Noddle 1984) so the figures are generally best viewed as a means of determining relative, rather than absolute age.

3.1.6.2 Eruption of teeth

The second ontological development that occurs in all mammalian skeletons is the eruption of teeth, which occurs in a given order for all mammals of the same species (Hillson 1986). Once again, this tends to happen at roughly the same age for all individuals in a given taxon, with some variation according to state of nutrition and can be used as a guide to the age of the animal. Studies of modern animals have allowed the assessment of the age at which the eruption of various teeth occurs (Payne 1973; Halstead 1985; Moran and O'Connor 1994).

3.1.6.3 Tooth wear

The above methods are useful for assessing the age of an immature animal, but for fully-grown mammals other methods must be found and the main one is the wear of teeth that occurs as the animal ages. Tooth eruption and wear have long been held to be more reliable indicators of age than other dental changes such linear measurements of growth and wear (of individual teeth or the mandibular tooth row) and the counting of incremental layers of secondary dentine and cementum layers (e.g. Lowe 1967). Although later work has demonstrated the value of studying cement layers (Stallibrass 1982; Brown and Chapman 1991b, 86, Lieberman and Meadow 1992) the methods used can be expensive and time-consuming so the tooth wear method remains popular due to its ease of application and the fact that no specialised laboratory equipment is required. Tooth wear analysis is based on the observation that mammal teeth wear down according to a regular pattern and studies of modern animals have allowed ageing schemes to be developed which show relative age according to the wear pattern on the teeth (Grant 1982, Payne 1973, 1987). While attempts have been made to attribute absolute ages to the development of wear patterns in teeth (e.g. Payne 1973, Halstead 1985), there seems little reason to suppose that patterns observed in, for example, Anatolian goats will parallel those in sheep elsewhere in the world. In fact it is to be expected that tooth wear will vary according to the diet of the animal and will probably be enhanced by animals ingesting sand (Mainland 2000), as they are likely to do if feeding on a machair plain. For those reasons, this is best treated as a means of determining relative rather than absolute age.

This inability to ascribe absolute ages to archaeological specimens is no disadvantage, as the relative age is arguably more important. For example, a sheep with teeth worn to the gums will be unable to eat and will die of starvation and whether it is seven or ten years old when this happens is largely immaterial. Predicting economic strategy from the age structure of a herd of animals (Payne 1973) relies on the relative numbers of animals at each relative age stage, not on the absolute ages of the animals.

3.1.6.4 Interpretation of age at death data

Age at death data are traditionally used to construct kill-off curves with which to interpret the economy (e.g. Payne 1973). Intrinsic problems exist with this approach. It is based on the assumption that the sample of animal bones can be regarded as representing a single population. This is unlikely to be the case. It also assumes that all bone has an equal chance of survival, taking no account of the likelihood that older or younger bone may be preferentially preserved. Furthermore, it assumes that an economically efficient strategy was always followed, which need not have been the case.

Even if these difficulties are ignored, and the survival curves drawn there are different approaches to how the results should be interpreted. High mortality of neonatal calves has been interpreted as indicating an economy where milking was of paramount importance (e.g. Legge 1992; Payne 1973). An alternative hypothesis, that a milking economy would be indicated by a high death rate of calves at the end of their first year of life has been proposed (McCormick 1992).

3.1.7 Metrical analysis

Measurements are of importance in charting the changes in size of animals over time. Several things may influence animal stature, primarily nutrition, which is in turn influenced by many things of archaeological interest. In the case of domesticated species the amount and type of fodder available in the winter months will affect the rate of development and growth of the animal. Animal husbandry decisions will also affect the size of the animals; the attempt to keep too many animals alive over a hard winter may result in stunted growth.

In the case of non-domesticated animals there are several examples of animals existing within an island niche at a different size from their mainland counterparts either because they represent relict populations, now extinct elsewhere, as in the Orkney vole (*Microtus arvalis* Pallas 1778; Groundwater 1974, 276) or because they have evolved to a larger or smaller size to exploit a niche unused on the particular island.

The adult size of red deer is particularly strongly linked to the nutritional environment in which they are living. Red deer from Scotland are smaller than those found elsewhere (Red Deer Commission 1981, 10; Clutton-Brock et al. 1982, 11) which is a reflection of the harsher environment in which they have to survive. Stags from Scottish hill populations reared in parks, plantations or farms can be up to twice as large as those remaining on the hills (Callandar and MacKenzie 1991, 54). The Scottish environment is hostile because vegetation species are limited and the soils mineral poor (Clutton-Brock et al. 1982, 11) and also because the weather conditions mean that the animals must expend considerable amounts of energy maintaining their body temperature (Red Deer Commission 1981, 24).

Measurements are also used in zooarchaeology to attempt to differentiate male and female animals. Metrical analysis may also be used to distinguish between wild, feral and domesticated animals where the archaeological specimen may be compared to a sample of modern bones from animals for which the domestic status is known (e.g. Bartosiewicz and Choyke 1991).

3.1.8 Quantification

Some of the many problems encountered when attempting to correlate the archaeological record with past reality have been detailed above. It can be expected, therefore, that any attempt to quantify assemblages may add a further layer of potential misunderstanding and inaccuracy to the process. The main aim of quantification is to assess the relative proportions of taxonomic animal groups in an archaeological assemblage. This will allow the worker "to define characteristics that clearly differentiate among groups" (Reitz and Wing 1999, 145). A great deal has been written on quantification (e.g. Davis 1987; Dobney et al. 1996; Grayson 1973, 1979; Lyman 1994; Maltby 1979) and, despite calls for standardisation (e.g. Grayson 1973) no general agreement has been reached. Indeed, at the 1998 conference of the International Council of Archaeozoology, a meeting with some of the most esteemed names in zooarchaeological research present, both on the panel and in the audience, no conclusion on the best method of quantification was reached. While the problem may be compounded by the fact that 'many archaeologists are afraid of...statistical theory in general' (Nance 1990, cited in Orton 2000, 11), most of the trouble lies in the information loss that occurs throughout the taphonomic processes described above.

The retrieved assemblage will represent a fraction of the death assemblage of the site, which, in turn may be a fraction of the life assemblage (Meadow 1980, 66; Davis 1987, 22 – 23;

Reitz and Wing 1999, 110-112). Therefore, it will not be possible to reconstruct the death assemblage, however carefully the sullegic processes are controlled.

Lyman (1994, 97) argues that a faunal worker has an advantage over the person working in lithics or ceramics in that there is a model (the living animal) from which to work. Arguably this is in fact a huge disadvantage, as it has led to a sort of jigsaw approach to quantification whereby attempts are made to "reconstruct" the animal, (and, by implication, even the herd) from the bones retrieved from an archaeological excavation. This is a misguided exercise, given the taphonomic considerations discussed above. Were the blue-print of the living animal not available then zooarchaeologists would have been in the same position as other archaeological workers, who do not know the number of ceramic fragments to each pot, or the number of grains on a barley plant. It can be envisaged that this might have led to a more useful zooarchaeological quantification method being devised, perhaps along the lines of that used by archaeobotanists, where the *relative* abundance of various taxa is noted. This, more descriptive, qualitative method would avoid the temptation to use inappropriate statistical methods which the use of numbers encourages, particularly today when a readily available software programme will do statistical analysis and produce impressive-looking graphs out of any column of numbers supplied to it. An example of how a more qualitative method could be adopted by faunal archaeologists is given by O'Connor (2000, 66).

It is important to remember that the result obtained from *any* quantification process will pertain only to the assemblage of bones on the analyst's desk. Furthermore, the count is really of 'all fragments attributed to that taxon by that analyst, rather than the total number of fragments which could have been attributed to that taxon, given more time or a different attitude to species attribution' (O'Connor 2000, 55). It is very easy to make inferences about the deposited assemblage, or even the death assemblage from the figures obtained from the retrieved assemblage; indeed that may be regarded by most as the reason for attempting quantification at all.

Given all the problems in relating the retrieved assemblage (for which quantification figures can be produced) to the death assemblage, or even the living animals, in which archaeologists are interested, what is the point of doing any quantification calculations at all? Unfortunately, quantification is unavoidable in zooarchaeology, even if only to give some estimate of the numbers of bones and animals one may be dealing with in the assemblage. This will give some idea of the extent to which assumptions made about the assemblage can be justified. It can be envisaged that a site producing, say, two large assemblages of 10,000 bones in which 80% are cattle might support an argument that the site had an economy based on cattle rearing. It would be harder to justify the same argument for a site yielding one assemblage of 50 bones, 40 of which had derived from cattle. Also, quantification facilitates comparison between assemblages and between workers, particularly if different workers use the same methods. It is therefore worthwhile considering the various merits and drawbacks of the different methods. It seems unlikely that a standard quantification methodology will ever be agreed, given the inherent problems with each method and the need for a flexible approach tailored to each specific site and research design. It is therefore imperative that faunal analysts clearly state their quantification methodology, and strive to overcome the various trephic processes that may hinder publication of this information.

The analyst must explain what is being counted; how it is being counted; and why specimens are counted that way. Three commonly used methods of quantification used in zooarchaeological analysis, and their drawbacks and advantages are detailed below.

3.1.8.1 Number of Identifiable Specimens (NISP)

The procedure of counting the number of specimens that can be identified to species appears to be the simplest and potentially the most accurate method of quantifying an assemblage. It has several inherent problems and biases, four of which can be corrected for:

Unequal recovery, where small bones may be missed when bone is hand-retrieved will bias against smaller specimens and/or smaller taxa. It can, however, be easily corrected by sieving (Payne 1972, 1975). Recovery technique has a very strong effect on the relative proportions of animals present in an assemblage, particularly on the presence of specimens from the smaller animals such as fishes, birds and molluscs (Grayson 1979; Reitz and Wing 1999, 145).

The fact that different species have different numbers of various elements (e.g. phalanges) in their skeletons will affect the bone count (Davis 1987, 36; Grayson 1973, 1979; O'Connor 2000, 56). For example, dogs have sixteen metapodial bones whereas horses have four. As the number of each skeletal element in the skeleton is known this bias can also be corrected, by simple arithmetic.

The fragmented nature of the bones in a collection means that there is a risk of counting a particular element more than once. This can be avoided by using diagnostic zones (e.g.

Dobney and Rielly 1988) ensuring that the zone counted is present in each species being considered and that the counts for each zone are recorded separately (Davis 1987).

Complete skeletons, in the form of animal burials skew the results, and bias the count, so must be excluded (Grayson 1973, 1979). The other problems inherent in this method of quantifying animal bone are not so easily dealt with.

NISP is biased in favour of larger bones, and bones from larger species, which are liable to break into more identifiable fragments than are smaller bones (Grayson 1973, 1979; Davis 1987; Maltby 1979). Thanatic processes, butchery and cooking in particular, contribute to this phenomenon, with larger bones being fragmented into more manageable pieces. Some of this bias towards larger bones and species will be offset by the fact that fewer of these specimens will have identifiable features on them.

Perhaps the biggest problem with NISP is that of element interdependence, the fact that specimens cannot be shown to be independent of each other. One bone may fracture into three or four separate identifiable specimens and it cannot be assumed that each specimen, or even each complete bone, has derived from a different animal. As most such tests assume specimens to be independent of each other this affects the type of statistic which can be used (Grayson 1979; O' Connor 2000, 56).

Comparison between taxa that differ in the number of identifiable bones in their skeletons will not be valid. Goat can only be identified on a few elements, compared to sheep and pigs, so it will obviously be poorly represented in an NISP count. Similarly different fish have different numbers of identifiable bones in their skeletons, so NISP is likely to bias the count in favour of the more highly identifiable species (O'Connor 2000, 57).

3.1.8.2 Minimum Number of Individuals (MNI)

Various means exist of calculating this figure, which aims to calculate the minimum number of animals that could have contributed their bones to the assemblage. Again, this method has several disadvantages.

It is difficult to replicate, as there are as many methods of calculating MNI as there are workers using it (Grayson 1979; Lyman 1994; Maltby 1979). It is generally calculated by counting the minimum number of skeletal elements or minimum number of anatomical units, but again, many different ways of calculating these figures exist. Compounding this are the differences in results obtained depending on how the site is divided, i.e. whether the MNI is calculated for the site as a whole, for each context, for each area unit (i.e. trench or feature) or for each occupation phase (Grayson 1979). These problems can be overcome if the analyst provides a detailed account of how they have calculated this figure, although the problem of getting such information published in a faunal report still remains.

One big drawback of MNI is the danger of it being taken as a literal figure, representing the number of dead animals in the assemblage, or, even worse, as having some relationship to the number of live animals present on and around the site. This is a common mistake made by people unfamiliar with the methodological theory of zooarchaeology, potentially the majority of the readership of most faunal reports. It has an inherent bias towards the rarer animals, with the presence of only one bone from a species resulting in an MNI equal to 1, which might be the same MNI calculated from twelve or three fragments of another species (O'Connor 2000, 55; Grayson 1973). In the case of birds, where many species may be represented by relatively few bones, this can pose a particular problem so it is recommended that birds be counted and analysed separately (Grayson 1973; Maltby 1979). It is essentially a useless figure, unsuited for statistical analysis of any sort, it being meaningless to add "more than two" to "more than two" to get more than four, therefore it adds little to the understanding of a site.

Advantages of calculating MNI do also exist. Large animals tend to be less prominent in the assemblage, due to the elimination of the problem of more than one identifiable fragment being counted from one element. Maltby (1979, 6) calculated average MNI figures for 100 identified specimens from three different species, cattle, sheep and pig. The figures were: cattle 4.54, sheep 6.72 and pig 7.82. Hence, this method of calculation may compensate for the probable over-representation of larger species in the NISP count.

MNI can be a useful clue as to how well represented a taxon might be in the assemblage. If a context contains a scatter of bones, from an uncommon taxon, and they are found to represent an MNI of 1 then it might be speculated that the bones represent a burial, or an accidental death. Alternatively the presence of several individuals in the same scatter of bones might be better interpreted as waste from some activity such as skinning or pest elimination.

3.1.8.3 Bone weights

Arguably the most accurate method of quantification is to weigh the bones. This would appear to be a way of obtaining some idea of the relative economic importance of the various species in the assemblage as it seems logical that the amount of meat on a skeleton will be reflected in the bone density. In mammals the weight of the skeleton does vary relative to the weight of the complete animal (O'Connor 2000, 57), making the weight method an attractive quantification method. However, certain caveats exist. Care should be taken to ensure that bones are clean and no soil, sand or grit is contained within them, which would influence the weight. It is not valid to compare different classes of animals by this method, bird bones being inherently lighter than those of mammals, and fish bones being structurally quite different from both these classes. Cultural dietary preferences affect which parts of the carcass are used, and, therefore, how much of any animal is used (O'Connor 2000, 58) and this will vary between species and also between societies.

3.1.9 Structured deposition

Animals have undoubtedly always been involved in human ritual and belief. Modern day examples are not hard to find, including Spanish bull-fighting and bull-running, British fox-hunting and stag chasing, the consumption of domestic fowl at Christmas and the avoidance of meat on Fridays and during Lent. Whilst the urbanisation of the greater part of the British population has led to most people today living a life very distant from the animals they eat, certain ritualistic animal use survives in our common language, most notably "killing the fatted calf". Animals are frequently involved in human superstition, even today some people believe black cats to be unlucky or lucky, (depending on human geographic location) and magpies and crows are similarly associated with good or bad fortune.

It seems highly probable therefore that animals were involved in human ritual in the past particularly given that more people would have been involved more closely with animals. The question of whether any of these animal rituals would have resulted in anything that would show up in the archaeological record is more difficult to answer. Of the modern day activities listed above some might be imagined to leave physical remains, possibly slaughtered Spanish bulls are all disposed of in one way, separately from other animal waste. Skulls of trophy animals killed in hunts are often displayed in public areas, where animal remains would not normally be expected.

Modern day sensibilities about cruelty to animals together with a general discrediting of superstition tend to blind us to possible sources of animal related ritual in the past. A notable example is the practice of building cats into house walls, presumably done in an attempt to repel rodents. This was practised as late as the eighteenth century AD in Bloomsbury in

London as revealed by recent rebuilding (Clutton-Brock 1999, 140). It is stated by Clutton-Brock that these cats were already dead, presumably deduced from the manner in which they were incorporated into the wall. It is possible that live cats may have been trapped in walls during construction, either by accident or human design.

Rituals involving animals are likely to have happened in the Late Iron Age. Some of these rituals or traditions may have left detectable traces, but it is unlikely that a modern mind will be equipped to understand what the motives and beliefs behind these rituals would have been. Nonetheless, recent studies have attempted to understand structured deposition of animal remains (Hill 1995) and these thoughts have influenced studies of the archaeology of the Western Isles (Mulville 1999; James and McCullagh 2003). It may be that some speculation around any apparent structured deposits of animal remains will be possible.

3.1.10 Other methods used

3.1.10.1 Element representation

The varying numbers of elements present on a site is traditionally studied in an attempt to understand human activities, in the assumption that human processes are the main modifier of the bone assemblage. Butchery and selection of body parts for purposes such as cooking, and tool manufacture can be envisaged as having an effect on the number and condition of the various elements present in a particular context. An example of how human activity might impinge upon element representation would be the use of hunting camps by hunters (e.g. Binford 1978). If animals are eviscerated and dismembered at the camp, to reduce the weight carried home then viscera, skulls and leg and foot bones would be left at the camp while prime meat producing bones are taken to the home and deposited there.

Similarly, a site producing joints of meat for consumption elsewhere will produce an animal bone assemblage dominated by low meat-bearing bones, while the site in which the joints are consumed will have a preponderance of high meat-yielding bones. While this is theoretically attractive there are many flaws, including the assumption of continuity of particular economic patterns being sustained over long periods of time. Another problem is with the assumption that the concept of the value of a bone has not changed over time. While modern Western society may appreciate animal carcasses primarily for the meat they produce, other products are also obtainable, such as sinews and marrow, which might increase the desirability or economic value of an element.

3.1.10.2 Structural density

The varying numbers of the different skeletal elements present on site can be studied through the consideration of the structural density of the bones and their relative utility. This exercise reflects a belief that taphonomic factors are the main agent affecting the survival of bones, and that the sturdier the bone the more likely it is to survive in an assemblage. This belief was acquired through the author's experience of analysing other bone assemblages prior to the ones involved in this study.

3.1.10.3 Utility indices

Utility indices are measures of the usefulness of each skeletal part. Binford (1978) published utility indices for caribou (*Rangifer tarandus*) and sheep (*Ovis aries*) based on the amount of meat, marrow and grease available on each skeletal part, with account taken for how accessible these commodities are. As he was working with Nunamiut hunters in the North American Arctic Binford was able to study their bone-working methods and consider their preferences and preconceptions regarding the different parts of the carcass. He constructed indices for meat (Binford 1978, 19 – 23), marrow (ibid., 23 – 31) and grease (ibid., 832 – 34), taking account of quantity and quality of the substances as well as carrying out time and motion studies on the relative ease of extraction of the material. Similar indices have been constructed for other species, including impala, guanaco, bison, phocid seal, musk-ox (full references, descriptions and the indices themselves in Lyman 1994, 231 – 234) and wild boar (Rowley-Conwy et al. 2002).

The other analytical methods used have largely been devised by myself, usually adapted from those employed by other workers, and will be described as part of the chapters presenting the results of the analysis (Chapters 4 and 5 below). This departure from the normal preferred practice of keeping methods and results separate is justifiable as many of the methods used are tailored to an exact situation and set of circumstances, and employed depending on the previously obtained results. Such flexibility of approach is required because each archaeological assemblage is unique and therefore should not be constrained within a rigid set of methodological rules.

3.2 Methodology

3.2.1 Taphonomy

The first order taphonomic processes are outwith the control of the archaeologist so will not be considered here. The effects of the second order processes can be modified by the excavation and analytical procedures followed. In the case of Bostadh and Beirgh, only the later analytical decisions were made by the author. Earlier decisions and the effect they had on the mammal bone data are considered below.

Sullegic processes are the archaeological activities that influence the material available for analysis (O'Connor 2000, 20). They include decisions concerning the area of excavation and policy about the retrieval of artefacts and environmental evidence. Archaeological decision making will be affected by the time and equipment available and by the calibre, experience, state of health and enthusiasm of the individual excavators. Devising a sampling strategy is also a sullegic process, one with considerable influence on the quantity and nature of the bones retrieved. At Bostadh, sampling decisions were largely left to undergraduate students working on the site; two, in particular, had a commendable enthusiasm and aptitude for environmental archaeology and a good awareness of many of the issues involved. While both individuals are competent, efficient archaeologists today they should perhaps not have been expected, as undergraduates, to have the knowledge required for some of the sampling decisions that the particularly difficult stratigraphy of the site involved. In the event, however, the sampling strategy at Bostadh appears to have been effective in producing a faunal assemblage containing a range of sizes of fragments. At Beirgh, the situation is different as a rigorous sampling strategy, again implemented by an undergraduate student, was only in place for the most recent season of excavation. Sampling in the early years of excavation was minimal, limited only to taking special "judgement" samples, particularly of waterlogged material.

3.2.1 Retrieval and sampling

3.2.1.1 Sampling strategy at Bostadh Beach

The research design at Bostadh incorporated a detailed post-excavation research plan and careful sampling was carried out to enable this. An integrated sampling strategy was devised and overseen by Mike Church and consisted of the sampling of all undisturbed, coherent archaeological deposits (total sampling). Bulk samples of between 14 and 28 litres were taken for processing using an oil-drum flotation tank fitted with a 1 mm mesh and 1.0 mm and 0.3 mm sieves catching the floating material (Church 2002). Other sampling was undertaken to address specific research questions. Of particular relevance to this research is the dry sieving (using 4 mm gauge sieves) of one in three buckets of soil excavated from the Norse midden and some floor deposits to retrieve bone and other artefacts (Church 2002). There was a consistent retrieval policy maintained over the excavation seasons so contexts from all four phases of occupation will have been treated in the same way.

During the excavation, animal bones were removed by hand from the trench. The hand-retrieved bones were dried on site and packed in polythene bags and boxes for transport to the Department of Archaeology in Edinburgh.

3.2.1.2 Sampling strategy at Loch na Beirgh

The situation at Loch na Beirgh is different from that at Bostadh, with a rigorous sampling strategy only being in place during the most recent excavation season in 1995. The sampling strategy consisted of random sampling of 20% of the contexts excavated (Church 2002, 62) and judgement sampling of certain contexts as deemed appropriate at the time. It is argued (Church 2002, 63) that this sampling strategy was a demonstrable success for the cellular occupation phases from which the assemblage analysed for this research originated. In practice however, when the current writer examined the material produced from the sample processing only one context from the 49 contexts producing bone for analysis was represented. The one bone produced from the sample processing of this one context was excluded from the analysis, so, the assemblage from Beirgh must be regarded as hand-retrieved only.

3.2.2 Preliminary analysis of the hand-retrieved bone

Unfortunately, the author was not the first person to analyse the hand-retrieved mammal bone from Bostadh as it was assessed and catalogued before the study commenced (Cook 1997a). Certain irreversible changes were made to the faunal material during this assessment, including the gluing of some unfused epiphyses onto diaphyses and some teeth into the wrong sockets. All identified bone fragments had context numbers written on them in thick blue marker pen, and when necessary some had the word "unfused" written on the bone shaft to indicate the original fusion state of the epiphysis. The changes made to the hand-retrieved bone resulted in certain problems. For example, the large context number labels, and the other writing on the fragments, made assessment of taphonomic indicators such as gnawing marks more difficult. It proved impossible to remove the glued epiphyses and the wrongly set teeth, so the mandibles concerned were removed from some analyses, mainly the age at death assessment. The report produced (Cook 1997a) could not assess the worth of the mammal bones for doctoral research since the definitive data structure report (Neighbour 2001), containing the final phasing of the contexts, was not available.

Doubts arose about the suitability of the Bostadh material for doctoral research soon after the current writer had started identifying and recording the bone fragments. It appeared likely that there would be insufficient data for meaningful statistical analysis regardless of the site phasing. Both of the author's supervisors had left the department by this time, so advice had to be sought elsewhere, on an informal basis and on the author's own initiative. It became clear that more data were required and an effort was made to find another assemblage that would provide comparative material. Fortunately, another assemblage from the Western Isles was located within the Department of Archaeology in the University of Edinburgh. A large number of bones had been retrieved from the excavations at Loch na Beirgh, Lewis, (Harding and Gilmour 2000), deriving from several occupation phases. Because of the small size of the Bostadh assemblage, a larger assemblage, ideally from one occupation phase, was sought from Beirgh. The bones were quantified in storage and an assessment made of the number of bones in each phase as far as the stratigraphy was understood at the time. Phase 5, the Final Cellular Phase, was selected for analysis as the contexts from it contained the largest number of bone fragments according to the assessment exercise. Subsequently, some minor re-allocation of contexts to phases has taken place, but it is not felt that this will make a great difference to the results produced in this research (D. W. Harding, pers. com.).

The material from Beirgh was not ideal for comparative research with the assemblage from Bostadh, as no consistent sample processing policy had been operational in the seasons when most of the Phase 5 contexts were excavated. However, an effort has been made to treat all the specimens identically throughout the post-excavation analysis conducted by the author. It is hoped that consistency in the trephic processes of identification and analysis will go some way towards compensating for variations in the sullegic processes of sampling and retrieval.

Problems were also encountered in devising a suitable phasing for the bone-bearing contexts from Bostadh. The data structure report was concerned primarily with architectural stratigraphy. It proved difficult to marry the accumulation of deposits with the architectural details. By definition, such accumulation deposits, like middens, for example, often build up over a long period, while some of the architectural detail such as a repair to a wall might reflect a very short period. Conversely, observations made during excavation revealed that large accumulations of sand could appear literally over night (T. Neighbour pers. com.). Consequently, difficulties were encountered in assessing the nature of deposited material within structures. Such deposits could have represented windblown sand, or slow accumulations of organic material into which the ubiquitous sand had become incorporated. Ultimately the author and a colleague working on the archaeobotanical material from the site interpreted the data structure report and devised a phasing that included the accumulation deposits that both could use (Chapter 4, below; Church 2002).

3.2.3 Identification

The specimens were identified as far as possible to element and species using atlases (Schmid 1972; Hillson 1986, Cohen and Serjeantson 1996) and the reference collections of defleshed and archaeological specimens in the Dept of Archaeology of the University of Edinburgh and the National Museums of Scotland. When a bone could not be definitely identified to one species it was assigned a category, such as "small ruminant" (sheep / goat / roe deer), or "large mammal" (cattle / red deer / horse). "Medium mammal" denotes sheep, goat, roe deer or pig, while the category "small mammal" includes dog, cat, fox and other small carnivores, such as otter and polecat. Smaller animals such as rats, mice and shrews were classified as micromammalia, and no attempt was made to identify the post-cranial elements to species. Distinction between sheep and goats was carried out using the metrical and morphological criteria detailed in Boessneck (1969).

3.2.4 Recording methods

Each specimen was identified to element, side of the body and species as far as possible and the fragmentation was noted following the zoning method described in Dobney and Rielly (1988). Broken specimens that could be rejoined were treated as separate specimens but the fact they joined together was noted on the database. No attempt to rejoin such specimens with glue was made; instead they were bagged up together in a small bag. The method of retrieval was noted; "H" represented a specimen retrieved in the trench and "S" was one retrieved through sample processing.

The specimen was then examined under a magnifying glass (4X) and strong light for any taphonomic markers. Burning and gnawing marks were noted, as was any staining of the specimen. An unstained specimen was rated "0" and one with 1 – 25% of its surface stained or discoloured was rated "1". Staining over 25 – 50% of the surface of the bone was given a "2", 50 – 75% a "3" and a specimen with 75 – 100% staining was rated a "4". No attempt was made to differentiate between possible sources of staining.

A method of assessing the state of preservation of the specimens was developed. Preservation state was measured by assessing the surface of the bone fragment, particularly its state of completion. As bones are worn by physical abrasion they lose some of their surfaces, exposing the cellular structure of the inner bone. If a specimen was fresh in appearance, with the surface shiny and complete, it was rated "A". If the bone surface was complete, but was dull in appearance it was rated "B". A specimen with an incomplete or broken surface with less than half of the surface area missing was rated a "C" and if more than half of the surface was absent it was rated "D". Reference specimens for each state of preservation were available for comparison to ensure consistency.

3.2.5 Butchery

Butchery marks were classified following Binford (1981) and the zone (Dobney and Rielly 1988) in which the butchery marks occurred was also noted.

3.2.6 Age at death

3.2.6.1 Epiphyseal fusion

Epiphyseal fusion ageing for cattle and sheep follows Silver (1969, 285-6; ages given for cattle and sheep). The epiphyseal evidence for sheep/goat, cattle and red deer was calculated by grouping the elements that fuse at the same age all together and totalling the number of fused and unfused elements for each category. Duplicate results from one bone fragment were ignored, for example, an unfused diaphysis shaft and the (unconnected) epiphysis that had been joined to it in life, were counted as one. On the relatively rare occasion that a bone fragment (generally a complete element) contained two fusion data then only the more important datum was counted. For example, a sheep/goat radius with both the proximal and the distal epiphyses unfused would be counted as being from an animal that was dead by the age of ten months (when the proximal radius fuses; Silver 1969, 285). Similarly, obvious neonatal bones would be counted as neonatal, regardless of the other fusion information data present, for example a metapodial in which the two digits had not yet fused together. Since the digits fuse around the time of birth in ungulates the presence of an unfused metapodial is a more useful indicator of age than is the unfused distal epiphysis which fuses much later (e.g. 18 – 24 months in sheep/goat (Silver, 1969). The percentage of fused elements for each category gives the percentage of animals still alive at that age stage. The methodology follows O'Connor (2000, 95).

3.2.6.2 Tooth eruption and wear

Tooth eruption and wear data in sheep/goat were recorded following Payne (1973) with the ages suggested for eruption and wear taken from Moran and O'Connor (1994). For cattle, the wear stages were recorded following Grant (1982) and the suggested ages of cattle were from Halstead's (1985) interpretation of eruption age and attrition data. For red deer the epiphyseal fusion ages are from Egorov (1967) and the dental ageing follows Brown and Chapman (1990, 1991a). Brown and Chapman's tooth wear methodology had been unfamiliar to the author prior to this study and the decision was made to assess the method in order to ascertain its suitability and / or the author's ability to follow what appeared to be quite a complex procedure. The presence in the reference collection of the Department of Archaeology in the University of Edinburgh of a set of red deer mandibles of known age made this exercise possible.

3.2.6.3 Interpretation of age at death data

No attempt to construct survival curves is made. A general impression of age at death is presented, based on presence / absence of the different mandibular age groups, and on percentages of fused and unfused epiphyses. Thus a general model of age at death data can be constructed and compared to various interpretative models (e.g. Payne 1973; McCormick 1992).

3.2.6.4 Assessment of Brown and Chapman's (1991a) method of mandibular tooth wear analysis

The method of quantifying wear of the mandibular molar teeth of the red deer given in Brown and Chapman (1990, 1991a) is described below.

The first and second mandibular molar teeth of red deer are comprised of four pointed cusps with a space (the infundibulum) separating them. The four cusps are arranged with two on the buccal (cheek) side of the tooth and two on the lingual (tongue) side. Both sets of cusps can be further divided into mesial and distal. The mesial cusp is nearer the middle of the jaw, i.e. nearer the front of the mouth, while the distal cusp is farther from the middle of the jaw, closer to the mandibular hinge. The mesial, lingual cusp is called the **paraconid** and the distal lingual cusp the **metaconid** while the mesial, buccal cusp is the **protoconid** and the distal buccal cusp the **hypoconid**. The third mandibular molar has an additional cusp, the **hypoconulid**.

For the purposes of the scoring system, a method of labelling the tooth is needed. The slope of each cusp is called area A, while the point on the cusp is area B. Areas C, D and E lie between the cusps and area L is the central infundibulum, left as "islands" of enamel as the tooth wears away. Areas F and G are between the mesial and distal cusps on the lingual and buccal sides respectively. The third molar has additional areas describing the fifth cusp. Area H is the lingual aspect of the cusp and I the buccal aspect, while area J is the "valley" area between the metaconid and the hypoconulid and area K the corresponding part between the hypoconulid and the hypoconid.

The method involves allocating points to the tooth according to the degree of wear present on each area. Wear on the slopes (A) was allocated one point for each slope where the enamel was worn at all. If the wear had exposed the dentine then two points were scored. As each cusp has two slopes a maximum of 16 points, per tooth, could be scored for area A. Area B scored one point if a pale central "eye" was present within the dentine between the slopes. Areas C to G scored a point if the dentine linked the cusps they surrounded. This information is summarised below. One point was allocated for each infundibulum that was worn away (a total score of 2 possible for M1 and M2 and 3 for M3).

Table 3.1 the scoring system from Brown and Chapman (1991a)

Area	Type of Wear	Score
A	Enamel wear on cusp slopes	1 (each slope)
A	Dentine wear on cusp slopes	2 (each slope)
B	Central "eye" of paler dentine between slopes	1 (each peak)
C	Dentine link between lingual and buccal cusps – mesial ridge	1
D	Dentine link between distal slopes of the two mesial cusps	1
D	Dentine link between mesial slopes of the two distal cusps	1
E	Dentine link between lingual and buccal cusps – distal ridge	1
F	Dentine link between lingual aspects of metaconid and paraconid	1
G	Dentine link between buccal aspects of protoconid and hypoconid	1
H	(3rd molar) Dentine exposed on lingual aspect of hypoconulid	1
I	(3rd molar) Dentine exposed on buccal aspect of hypoconulid	1
H+I	(3rd molar) Dentine linking H and I	1
J	(3rd molar) Dentine link between hypoconolid and metaconid	1
K	(3rd molar) Dentine link between hypoconulid and hypoconid	1
E	(3rd molar) Link between hypoconid and metaconid, distal ridge	1
L	Infundibulum worn away	1 (for each)
	Black staining of exposed dentine	1 (for each)

Table 3.2 Maximum scores possible for M1 and M2:

Dentine wear on all cusp slopes	8 x 2 =	16
Central "eye" present on all peaks	4 x 1 =	4
Dentine link present on C		1
Dentine link on D		2
Dentine link on E		1
Dentine link on F		1
Dentine link on G		1
Infundibulum worn away		2
Black staining of exposed dentine (Areas A - G)		18
Total		**46**

Table 3.3 Maximum scores possible for M3

Dentine wear on all cusp slopes	8 x 2 =	16
Central "eye" present on all peaks	4 x 1 =	4
Dentine link present on C		1
Dentine link on D		2
Dentine link on E		1
Dentine link on F		1
Dentine link on G		1
Infundibulum worn away		3 (1 each, as in M1 + 1 for hypoconulid)
Black staining of exposed dentine (Areas C - G)		6
Dentine exposed, area H		1
Dentine exposed area I		1
Dentine linking H and I		1
Dentine exposed area J		1
Dentine exposed area K		1
Dentine exposed area E (2nd and 3rd cusp)		1
Black staining of exposed dentine		24 (for each A - G)
Total		**65**

The method was applied to mandibles of known age contained within the reference collection of the Dept of Archaeology in the University of Edinburgh. The results are displayed in Table 3.4 below

Table 3.4 The results of the Brown and Chapman tooth wear analysis

Lab ref.	M1		M2		M3 (A - G)		M3 (H – L)		TOTAL
Bz 2.1	A	13	A	0	A	0	H	0	**15**
	B	0	B	0	B	0	I	0	
	C	0	C	0	C	0	H+I	0	
	D	0	D	0	D	0	J	0	
	E	0	E	0	E	0	K	0	
	F	1	F	0	F	0	L	0	
	G	1	G	0	G	0			
	L		L						
Total		15		0		0			
Cz 1.1	A	16	A	0	A	0	H	0	**16**
	B	0	B	0	B	0	I	0	
	C	0	C	0	C	0	H+I	0	
	D	0	D	0	D	0	J	0	
	E	0	E	0	E	0	K	0	
	F	0	F	0	F	0	L	0	
	G	0	G	0	G	0			
	L		L						
Total		16		0		0			
Cz 1.3: ce (2)	A	16	A	16	A	2	H	0	**35**
	B	0	B	0	B	0	I	0	
	C	1	C	0	C	0	H+I	0	
	D	0	D	0	D	0	J	0	
	E	0	E	0	E	0	K	0	
	F	0	F	0	F	0	L	0	
	G	0	G	0	G	0			
	L		L						
Total		17		16		2		0	
Cz 1.4: ce (4)	A	16	A	16	A	9	H	0	**45**
	B	0	B	0	B	0	I	0	
	C	1	C	1	C	0	H+I	0	
	D	0	D	0	D	0	J	0	
	E	1	E	0	E	0	K	0	
	F	0	F	0	F	0	L	1	
	G	0	G	0	G	0			
	L		L						
Total		18		17		10			
Cz 1.5: ce (5)	A	16	A	16	A	16	H	1	**65**
	B	4	B	2	B	2	I	1	
	C	1	C	1	C	1	H+I	1	
	D	1	D	0	D	0	J	0	
	E	1	E	0	E	0	K	1	
	F	0	F	0	F	0	L	0	
	G	0	G	0	G	0	E	0	
	L		L						
Total		23		19		23			

Table 3.4 The results of the Brown and Chapman tooth wear analysis

(continued)

Lab ref.	M1		M2		M3 (A - G)		M3 (H – L)		TOTAL
Cz 1.6: ce (6)	A	16	A	16	A	16	H	0	60
	B	4	B	0	B	0	I	1	
	C	3	C	1	C	0	H+I	0	
	D	1	D	1	D	0	J	0	
	E	1	E	0	E	0	K	0	
	F	0	F	0	F	0	L	0	
	G	0	G	0	G	0	E	0	
	L		L						
		25		18		17			
Ce (7)	A	16	A	16	A	16	H	0	64
	B	2	B	3	B	0	I	1	
	C	1	C	1	C	0	H+I	0	
	D	2	D	1	D	0	J	0	
	E	1	E	1	E	0	K	0	
	F	1	F	0	F	0	L	0	
	G	1	G	1	G	0	E	0	
	L		L						
		24		23		17			
Ce (8)	A	16	A	16	A	16	H	0	70
	B	4	B	4	B	0	I	1	
	C	1	C	1	C	1	H+I	0	
	D	1	D	2	D	1	J	0	
	E	1	E	1	E	1	K	0	
	F	1	F	0	F	0	L	0	
	G	0	G	1	G	1	E	0	
	L		L						
		24		25		21			
Ce (9)	A	16	A	16	A	16	H	1	80
	B	4	B	4	B	2	I	1	
	C	1	C	1	C	1	H+I	1	
	D	2	D	2	D	1	J	1	
	E	1	E	1	E	1	K	1	
	F	1	F	1	F	0	L	0	
	G	1	G	1	G	1	E	1	
	L		L						
		26		26		28			
Cz 1.8: ce (10)	A	16	A	16	A	16	H	1	80
	B	4	B	4	B	2	I	1	
	C	1	C	1	C	1	H+I	1	
	D	2	D	2	D	1	J	1	
	E	1	E	1	E	1	K	1	
	F	1	F	1	F	1	L	0	
	G	1	G	1	G	0	E	1	
	L		L						
		26		26		28			

Table 3.4 The results of the Brown and Chapman tooth wear analysis (continued)

Lab ref.	M1		M2		M3 (A - G)		M3 (H – L)		TOTAL
Cz 1.9: ce (11)	A	16	A	16	A	16	H	1	84
	B	4	B	4	B	4	I	1	
	C	1	C	1	C	1	H+I	1	
	D	2	D	2	D	2	J	1	
	E	1	E	1	E	1	K	1	
	F	1	F	1	F	1	L	1	
	G	1	G	1	G	0	E	1	
	L		L						
		26		26		32			
Cz 1.10: ce (12)	A	16	A	16	A	16	H	1	79
	B	4	B	4	B	4	I	1	
	C	1	C	1	C	1	H+I	1	
	D	2	D	1	D	1	J	1	
	E	1	E	1	E	1	K	1	
	F	1	F	1	F	0	L	0	
	G	1	G	0	G	0	E	1	
	L		L						
		26		24		29			
Bz 1.10	A	16	A	16	A	16	H	1	85
	B	4	B	4	B	4	I	1	
	C	1	C	1	C	1	H+I	1	
	D	2	D	2	D	2	J	1	
	E	1	E	1	E	1	K	1	
	F	1	F	1	F	1	L	1	
	G	1	G	1	G	1	E	1	
	L		L						
		26		26		34			
Unlabelled	A	16	A	16	A	13	H	0	51
	B	2	B	0	B	0	I	0	
	C	1	C	1	C	0	H+I	0	
	D	1	D	0	D	0	J	0	
	E	1	E	0	E	0	K	0	
	F	0	F	0	F	0	L	0	
	G	0	G	0	G	0	E	0	
	L		L						
		21		17		13			

The scores achieved for these molars of known age were compared to the results given in Brown and Chapman (1991a, Fig 5, 531).

Table 3.5 comparison of molars of known age with results from Brown and Chapman (1991a, Fig5, 531)

Lab ref	Score	B & C age (months)	Known age
Bz 2.1	15	8 – 14	
Cz 1.1	16	8 – 14	
Cz 1.3: ce (2)	35	15 – 28	24 - 35
Cz 1.4: ce (4)	45	19 – 36	48 - 59
Cz 1.5: ce (5)	65	36 – 54	60 - 71
Cz 1.6: ce (6)	60	25 – 50	72 - 83
Ce (7)	64	36 - 54	84 - 95
Ce (8)	70	30 - 60	96 - 107
Ce (9)	80	36 – 70	108 - 119
Cz 1.8: ce (10)	80	36 – 70	120 - 131
Cz 1.9: ce (11)	84	36 – 76	132 - 143
Cz 1.10: ce (12)	79	36 – 76	144 - 155

In each instance the scores for the mandibles for the reference collection mandibles were found to give much lower ages when assessed following Brown and Chapman's system than their known age. That may be due to the current writer not accurately replicating Brown and Chapman's system, so reasons for this should be sought. Two of the criteria in Brown and Chapman's scoring system are somewhat ambiguous; they rely on noticing colour differences on area B (the white "eye") and the points given for blackened dentine. None of the mandibles from the reference collection had any dentine discoloured to the point where it was considered black, so no points were given in this category. However as Brown and Chapman (1991a, 534) note there is much decreased accuracy in predicting the ages of red deer through tooth wear patterns in older individuals than in younger ones. This is possibly caused by variations in the biology of the individual deer, such as differences in chewing patterns or in the hardness of enamel and dentine within the teeth (Kiedorf and Becher 1997). Hence the results above may not reflect inadequacies within the method, or in the current worker's interpretation of the method, but may support the assertion that tooth wear analysis is of limited use for attributing age in older animals (Murie 1951, cited in Lowe 1967; Moran and O'Connor 1994, 279; Brown and Chapman 1991a, 533 – 4). Tooth wear is considered to be more useful for estimating age in younger mammals, as the stages of eruption follow a pattern, which affects the wear patterns, but individual variation in diet and chewing behaviour may be affecting the wear patterns in later life. Red deer in particular have teeth less suited to wear analysis, as the mandibular tooth row is longer than the maxillary tooth row (Murie 1951, cited in Lowe 1967, 145), allowing more individuality in chewing behaviour than if the tooth rows were the same length. It can be appreciated that an individual chewing more on the posterior molars than the anterior ones would display different tooth wear patterns than one habitually chewing towards the front of the mouth.

Admittedly the sample size is small, and had the initial results related better to Brown and Chapman's findings more deer mandibles of known age might have been assessed. However the small size of the assemblage of retrieved red deer mandibles militates against spending further time on this exercise.

It is, of course, important to remember the reason for attempting to obtain information from archaeological material, and in the case of assessing the age of mammalian remains there are at least two possible advantages. One is to allow economic models to be drawn up (*sensu* Payne 1973) and the other is to study seasonality.

While the status of the red deer in the local economy may be in doubt (McCormick, forth) it seems unlikely that the ecology and behaviour of the animals (Clutton-Brock et al 1982, Darling 1937) would permit any detailed economic manipulation of the beasts. Tooth wear analysis is, therefore, of little importance in shedding light on the economic strategies concerning exploitation of red deer.

Seasonality may reveal information about seasonal site occupation (e.g. Legge and Rowley-Conwy 1988) or it may tell us something of the resource exploitation throughout the year. Studying the ecology and behaviour of animal species, together with age data, adds to our understanding of seasonal exploitation of available resources (e.g. Legge and Rowley-Conwy 1988; Serjeantson 1998; Cerón-Carrasco 1998). Recent work has suggested that tooth wear analysis is unsuited to studying seasonality as even the wear patterns on the earliest erupting teeth vary considerably in animals known to be of the same age (Moran and O'Connor 1994, O'Connor 1998, Tables 1 & 2, 8 - 9). Therefore the few intact red deer mandibles retrieved from the two Western Isles sites are compared to a set of mandibles of known age, taken from Scottish red deer, and a rough estimate of their age, based on tooth wear, is made. This is justified because, as only 12 red deer mandibles suitable for ageing were retrieved from Bostadh, and no red deer mandibles with tooth rows intact were retrieved from Beirgh, it was apparent that no detailed population reconstruction would be obtained for either site. Instead only a general picture of the ages of animal exploited could be gleaned.

It has been demonstrated that due to the problems discussed above there is little to be gained from attempting a detailed analysis of red deer age through studying tooth wear patterns. It can be readily seen, from Appendix 3.2: Table 5 above, that the range of possible ages attributed to each wear stage will mask any information on seasonality. It is therefore argued that assessing the few suitable red deer mandibles retrieved, i.e. those with the relevant molariform teeth present within them, by visually comparing them to a set of mandibles of known age is adequate for the present purposes.

3.2.7 Metrical analysis

Measurements were taken on complete specimens from adult animals following von den Dreisch (1976).

3.2.8 Quantification

Three main quantification methods, number of identifiable specimens (NISP), minimum number of individuals (MNI) and weight have all been used in this analysis. The calculation methods employed to derive secondary data, in particular the method used for calculating MNI, vary greatly between workers, so must be explained in detail if the results are to be in any way comparable with those obtained elsewhere. Therefore, the MNI calculation method used is detailed (3.2.8.3).

An effort has been made to differentiate between primary and secondary data (O'Connor 1985) and both are presented in graph form.

3.2.8.1 Primary data

The number of identifiable specimens (NISP) was calculated from the database by selecting the phase and species through the creation of a query in Microsoft Access (example: Phase 1 at Bostadh presented in Appendix 3.2). This was then exported to Microsoft Excel and a pivot table created to derive the quantities of each species retrieved. The only specimens included in this calculation were those that could be identified to species, rather than to sub-family or a range of possible taxa.

3.2.8.2 Secondary data

Calculation of the primary data ignores a large category of specimens - those specimens identified as either sheep or goat (sheep/goat). Only a few zones on a few elements are distinguishable between sheep and goats on metrical or morphological criteria (Boessneck 1969). It is therefore inevitable that a high proportion of bones will be identifiable only as "sheep/goat".

In the assemblages from both Beirgh and Bostadh specimens identified as sheep vastly outnumber those identified as goat so it can be assumed that the great majority of specimens categorised as sheep/goat are derived from sheep. Consequently the figures for sheep will be greatly underestimated in the primary data figures. For this reason an intermediate data category is created in which the sheep/goat figures have been adjusted to compensate for the under-representation of sheep in the primary figures. For example, if specimens identifiable to sheep constitute 95% of the total specimens identified to both sheep and goat, then it could be assumed that around 95% of the fragments that were identified as sheep/goat are likely to have derived from sheep. The adjusted figure for sheep can therefore be obtained by adding 95% of the sheep/goat specimens to the number of specimens retrieved identifiable as sheep.

Sheep2 = sheep + (0.95 x sheep/goat)

These secondary data figures, which incorporate the sheep/goat specimens only, are called "sheep/goat adjusted".

This is perhaps better demonstrated with the use of an example. In the Bostadh assemblage from Phase 1 there was one specimen identified as goat while 45 were identified as sheep and a further 73 fragments were identified as sheep/goat. Thus of the specimens identified as a single sheep/goat species, i.e. either sheep or goat, 98% were identified as sheep and 2% as goat. If it is assumed that this ratio also applies to the fragments identified as "sheep/goat" then it can be estimated that 98% of the 73 sheep/goat fragments were derived from sheep (=72). Adding this figure to the original number of fragments identified as sheep (45) gives a new total for sheep (117), which is referred to as the adjusted NISP. All NISP figures are given as whole numbers, as they refer to the number of identifiable specimens retrieved and it is not possible to have a fraction of a specimen.

Table 3.6 an example of how the sheep/goat fragments were allocated to sheep or goat

Species (no. fragments) retrieved	Number of fragments	%
Sheep	45	98%
Goat	1	2%
Sheep + goat	46	
Retrieved "sheep/goat"	73	
Recalculated figures		
Sheep2	45 + (0.98 x 73) = **117**	
Goat2	1 + (0.02 x 73) = **2**	

Sheep/goat bones constituted the largest category of specimens that could not be identified to a single species but other categories were also created. A specimen that could possibly have derived from sheep, goat or roe deer was termed "slr" (small ruminant) and one which could have derived from sheep, goat, roe deer, pig or large dog was "mdm" (medium mammal). Likewise, with the fragments from the larger species, the category "lgr" (large ruminant) could be cattle or red deer, while "lgm" (large mammal) could be cattle, red deer or horse. In order to include these fragments in the quantification analysis the fragments in these categories were allocated to a single species according to the relative proportions of each taxon present in each category

The reallocation process described above was carried out for the weights as well as for the number of all identified specimens. Together with the MNI figures therefore, three different methods of quantification were undertaken.

Another method of assessing the relative number of taxa is to quantify the relative numbers of eight frequently recovered homologous elements (Bond and O'Connor 1999, 338). The method goes some way to counteracting several taphonomic effects, firstly by counting only elements that are structurally dense and likely to survive in archaeological deposits. The elements counted (NISP) are mandible, axis, scapula glenoid, distal humerus, distal tibia, proximal metacarpal, proximal metatarsal and the pelvis acetabulum. The NISP figures were arrived at through searching for the elements and species with Queries in the Access database. The method also helps counteract the over-representation of larger animals and larger bones, due to fragmentation, that is a feature of the NISP calculation (Bond and O'Connor 1999, 338). The homologous element (HE) figures were calculated for cattle, red deer and sheep/goat (i.e. elements identified to sheep/goat and to sheep). To allow abbreviation the word "sheep" was used to denote the homologous element figure for sheep/goat plus sheep hence the homologous element figure elements identified as sheep/goat and sheep can be denoted HE_s. Every effort has been made throughout the thesis not to assimilate the two categories of identification level and this is the only time that sheep/goat and sheep are regarded as equivalents. The need to abbreviate is brought about by the next stage in the procedure, the representation of the data in "cattle equivalents" whereby the homologous element figure for sheep/goat and that for red deer are divided by the figure for cattle. This procedure allows a graph to be drawn that indicates the relative proportions of the three main taxa, reducing the interdependence of the data. A high count for one taxon cannot depress both the other taxa when the data are represented this way (Bond and O'Connor 1999, 338).

3.2.8.3 Calculation of MNI

The MNI figures were calculated without taking fusion state or element size into account. No attempt was made to quantify MNI while the bones were on the analyst's bench as has been the practice of the author in the past. In the case of the assemblage from Bostadh it was not possible to assess the minimum number of elements (MNE) for each element for each phase when the elements were being identified and recorded, because no phasing information was available. When the phasing information was released (Neighbour 2001), the identification and data recording was complete and the bones repackaged. It was therefore necessary to calculate the MNE from the database. The table containing all the fragment information on the Microsoft Access database was copied to a Microsoft Excel file. A pivot table was made to calculate the number of left and right skeletal zones (Dobney and Rielly 1988) present for each element from each species. The largest number of zones, either right or left, on each element was taken as the minimum number of elements present. The largest MNE figure for each species was taken as the MNI for that species. In the case of the sheep/sheep/goat specimens, the assumption was made that the vast majority of sheep/goat specimens in fact derived from sheep, so all specimens identified to "sheep/goat" and *Ovis aries* were used in the calculation. It is justifiable to assume all sheep/goat bones derive from sheep because the numbers of specimens identified as goat were negligible, and have not as yet been confirmed as goat by a second opinion from another worker. Such confirmation would be worth obtaining since goat has not been identified in the (admittedly small) zooarchaeological record from the Western Isles during the Iron Age (McCormick n.d.).

3.2.9 Structured deposition

The presence of pits containing bones under some of the house floors at Bostadh, together with horse bones in what were believed to be floor deposits suggested that there might be evidence of symbolic deposition of animal bones at Bostadh. Deposits underneath floors are of interest because they are often regarded as deliberate "offerings" made at the time of construction of the building; although whether this is due to modern sensibilities being offended at the idea of disposing of waste within a domestic living space is a moot point. Horse bones tend to arouse suspicion in these circumstances as horses are generally disposed of differently from other livestock. There are a few possible reasons for this, the greater value of the horse, including a possible sentimental one, the possible aversion to eating horsemeat that would necessitate the disposal of the body differently from those of other animals. There is also a danger that modern sentimentality and superstition about horses may colour our judgement of horse remains found in archaeology, leading us to find meaning where it need not necessarily exist. Structured deposition of bones is a subjective issue and it is hard to envisage an objective approach to it. Regardless of any patterns detected it seems unlikely that the reason for any such deliberate placing of bones, the belief system behind the behaviour, will ever be understood.

Setting those considerable differences aside, the decision was made to examine each context that contained bones and consider the elements and species within it together with the context location and characteristics to see if any pattern could be noted. Essentially a descriptive approach, this attempt to link the archaeological structures with the animal bone assemblage should illuminate any interesting features of the deposited assemblage that are missed in the more objective analytical techniques attempted elsewhere. For Bostadh, this procedure was carried out for each house separately.

3.2.10 Analytical methods

3.2.10.1 Body part representation

A count was done of the number of fragments (NISP) of four elements representing the hind limb and forelimb of the ungulate body in order to ascertain whether there was any evidence of a prevalence of either. An equal number of hind and fore limbs would suggest that animals may have been taken onto site as prepared quarters of meat, rather than as complete carcasses or live animals. Since the results were inconclusive, it was thought that fragmentation of the bones might be affecting them and so the test was repeated using the minimum number of elements (MNE). The MNE is the highest number of zones (Dobney and Rielly 1988) present for any element, not taking side or size into account. Side was not considered because it was believed to be unlikely that an animal would be represented by more than one of the same element in the deposited assemblage. It is difficult to match elements together and attribute them to one animal, as the assumption is made that animals are symmetrical, which is not necessarily the case. Furthermore, quantifying the minimum number of elements by considering side of the body and maturity could only be properly attempted by collecting all the elements from one phase together on a laboratory bench and attempting to match them. For the Bostadh assemblage the phasing was not available until three and a half years after the PhD research had started, long after the bones had been examined and catalogued on the database, so it was not possible to examine all the bones from one phase together. This was not the case with the assemblage from Beirgh where the bones were selected for examination because they belonged to the same phase. For the sake of comparability between the two assemblages it was considered better to use exactly the same methodology on both.

The question of whether the animal bone assemblage contained any evidence of whether the site had been a producer or consumer site was investigated by counting the MNE of six elements that were high meat yielding, the pelvis, scapula, femur, humerus, radius and tibia. The figures achieved were compared to a count of six low-meat yielding elements, the mandible, calcaneum, astragalus and the three phalanges. As phalanges are four times more abundant in the body than the other elements their totals were divided by four before adding to the total.

3.2.10.2 Element distribution

The assumption was made that the animals were introduced to site as complete carcasses, with no preference for right or left sides of the body nor for fore or hind quarters. This assumption allows an element distribution chart to be drawn up, depicting the numbers of the various elements retrieved, from which hypotheses can be drawn about any preferential importing of body parts. The long bones (humerus, radius, metacarpal, femur, tibia, and metatarsal) were treated differently. Many of these bones have densities which vary over their length, for example the proximal end of the humerus is rounder and more cancellous (spongiform) than the denser, squarer, distal end. Such factors are likely to affect preservation. For this reason each end of these long bones was quantified separately for this exercise.

This procedure was carried out for each species present in each phase with an NISP of greater than 100. This figure was chosen arbitrarily and allows element analysis to be carried out for cattle and sheep/goat in all four phases, at Bostadh, and for red deer in phases 3 and 4.

The numbers of each zone (Dobney and Rielly 1988) of each element retrieved for each species were counted. A zone on an element was counted if more than 50% of it was intact, with no account being taken of the side of the body from which it derived. For the Bostadh data this exercise was carried out for each phase (and/or for the combined phases). The largest number of zones counted from each element was taken as representing the number of elements retrieved (R). The method of calculating the element distribution follows

O'Connor (2000, 72 - 73), where the number of elements retrieved are divided by the number of that element in the individual body (I) to produce the "observed" count (O). The "observed" or "modified count" for each element can be totalled and the arithmetic mean calculated to produce an "expected" figure (E), and O/E produces a number illustrating how much more or less than expected the frequency of any given element is (O'Connor 2000, 72). A value of 3 would indicate the element was three times more numerous than might be expected. The standard deviation was also calculated and the figures lying above one standard deviation from the mean were denoted in bold font and those more than one standard deviation below in italic font. The figures are provided in Appendix 4.1 and are displayed as bar charts (figures 4.11 to 4.13) to provide a general measure of abundance of various skeletal zones. The element representations were then compared for each of the taxa against each other in order to investigate whether taphonomic processes were affecting the element distribution patterns in each taxon in a similar manner. In order to investigate further what factors may have influenced the element distribution the relative abundance of different element zones was compared to the distributions that might be expected in a variety of cultural situations, such as producing meat joints for export off the site.

3.2.10.3 Structural density of skeletal elements

The use of the term "structural density" follows Lyman (1994, 237) and reflects the measurement of the ratio of the mass of a substance relative to its volume. Measurement of the structural density of a skeletal part will be an "average characteristic of the sample measured" (Lyman 1994, 237) and will reflect an "average" reading over any one cross-section of bone measured, and also an average (mean) of figures taken from a small sample of different individual animals. For these reasons Lyman (1994, 252) recommends they be regarded as ordinal level statistics at best. Hence, the element zones were listed in order of decreasing density for comparison with the amounts of each skeletal zone retrieved and are depicted in the bar charts with the most dense at the left and bone structural density decreasing along the x-axis. In the cases where more than one value for structural density is given for any bone end or zone the smallest figure is taken, following the "weakest link" assumption, i.e. that the strength of the weakest part of the bone will determine its chances of survival.

Lyman's (1994, 240 –1, 246 – 7) structural density index for sheep was used for analysing the sheep/goat element distribution pattern. Cattle and sheep/goat element distribution were also studied using Ioannidou's (2003, 358) figures for sheep and cattle. The latter was carried out for the Beirgh data only, because of the larger sample size.

Ioannidou's (2003, 358) bulk density figures for cattle were used on the Beirgh assemblage and only for the assemblage from Phase 2 at Bostadh. Phase 2 was the phase with the largest number of cattle bone fragments retrieved but the results were inconclusive, so the exercise was carried out for the site as a whole in order to increase the sample size.

No structural density figures for red deer could be obtained from the literature and the nearest "equivalent" taxa for which figures were available were "deer, (*Odocoileus* spp.)" calculated by Lyman in his PhD thesis and listed in Lyman 1994 (246 – 7). Reservations were felt about using these figures, particularly as some species of the genus *Odocoileus* are very much smaller than red deer. Indeed, even within one species, white-tailed deer (*Odocoileus virginianus*) body size can vary enormously, with adult weight ranging between 34 and 181 kg (Reitz and Wing 1999, 226). Such variation is bound to affect the structural density of the skeleton and so the value of applying data from specimens of unknown size to another species appears dubious. For this reason, the test was applied first to the largest assemblage of red deer bones and subsequent use was dependent on that result.

The structural density results may have been affected by the procedure used to calculate density values for each element, particularly the selection of the smallest structural density value to represent the density of a skeletal part. Therefore, another method of analysis was undertaken. The fact bone fragmentation was recorded by noting the zones (Dobney and Rielly 1988) present on each specimen permitted the analysis of the relative abundance of each zone. The bone zones could be correlated with the structural density figures provided by Lyman (1994, 240 – 247) and arranged in order of decreasing structural density. The quantities of each bone zone for which density figures were available were calculated, adjusted according to their frequency in the ungulate skeleton, and arranged in order of decreasing structural density. Unfortunately, structural density figures for sheep mandibles were not available, so the mandible has had to be excluded from this analysis.

3.2.10.4 Utility indices

Binford's (1978) normed general utility indices (listed in Lyman 1994, Table 7.1, 226) were also investigated to check whether a correlation between them and the MAU (minimum anatomical unit) figures obtained existed. The MAU figures were taken from the column headed "O" in the original element distribution calculations as described above. The MAU figures were plotted against the normed general utility index (%GUI) and the normed modified general utility index (%MGUI) to investigate whether any correlation could be detected. This was first illustrated as a scatter diagram, which assumes the %GUI and %MGUI figures can be considered as interval level data. Given that utility indices are calculated from a small number of individual animal carcasses and so do not reflect variation between individuals, due to age, sex or nutrition, it is perhaps better to consider the utility indices as ordinal scale only (Lyman 1994, 234). For this reason a second set of figures have been produced in which the skeletal zones are arranged along the x-axis in order of decreasing %GUI or %MGUI.

3.2.11 The bird remains

The bird remains were treated differently from the mammal bones for several reasons. Bird bones vary greatly in size and structure from mammal bones, so are differently affected by taphonomic processes. As the author has limited experience of identifying bird bones, and because a suitable, disarticulated, reference collection was not readily available in Edinburgh, no attempt was made to identify the few (< 100) bird bones retrieved from the sample processing at Bostadh. There are particular difficulties inherent in identifying bird bones that arise from the taxonomic classification of birds into more species per family than mammals (O'Connor 2000, 38) and there are close skeletal similarities between genera within families and between species within genera. In the case of sea birds, where adaptation to a particular environmental niche results in similar body shapes across several genera, it is difficult enough to identify the various species of auks and waders alive, let alone identify a bone fragment accurately to a species. In addition, the occurrence of migrants and occasional visitors to the British coast greatly increases the range of possible birds that might be present and thus should be included in the identification process. It is not intended to imply here that bird bone identification is impossible, nor to cast doubt on the many talented people who have many years experience of working with bird bone. Instead, in the particular circumstances of Bostadh, the current writer felt it was too difficult, particularly without a suitable reference collection, to do justice to the identification of the bird bones retrieved from the sample processing at Bostadh. The hand-retrieved material, had been catalogued previously by another worker (O'Sullivan 1997), will be discussed in the following chapter (4.8).

3.3 Conclusion

This chapter has discussed some of the theoretical and methodological issues that the zooarchaeologist has to be aware of when interpreting animal bones. Not all the issues will concern every worker, nor affect every bone assemblage, but it is necessary to declare the ones that are of primary concern and interest to the particular worker and assemblage(s) under consideration. The importance of taphonomy has been stressed throughout this chapter and is held to have a huge influence on the level of information that can be obtained from any animal bone assemblage.

The methodologies pursued in the analysis of the two assemblages have also been explained, often in some detail, in the second half of this chapter, which should enhance understanding of the results obtained. While it is acknowledged that such attention to methodological detail may make for heavy reading, it is essential due to the lack of standardised techniques and approaches to zooarchaeological analysis and interpretation. The apparent desirability of such standardisation is illusory, as it is important that theoretical and methodological approaches are adaptable, both to fit the unique qualities of the particular assemblage and site and to incorporate new approaches as they are developed.

Chapter 4 The analysis of the data from Bostadh Beach

4.0 Introduction

Chapter 4 presents the results from Bostadh. Through the investigation of relative abundance of species; body part and element representation; age at death; and taphonomic indicators; an attempt is made to understand aspects of the economy and environment of the site. The analysis is hampered somewhat by the small size of the assemblage. It was considered that the four phases of occupation at Bostadh represented important cultural change, including the arrival of the Norse, so the decision was taken not to routinely combine the bones from any of the occupation phases distinguished by the excavator. In particular, bone fragments from Phases 3 and 4 are always analysed separately as they are believed to represent the arrival of the Norse and their subsequent cultural dominance. The figure-of-eight houses at Bostadh were built by digging into the sand dunes and establishing a structural chronology is therefore difficult. Of particular relevance to zooarchaeologists, some of the most problematic contexts to attribute to a particular cultural phase are the accumulation deposits, such as middens, which are likely to contain most of the bones and other environmental evidence.

The species retrieved and the relative abundance in which they are present in the assemblage from Bostadh is discussed first, then the body part representation and element distribution data are discussed. The age at death data is examined; then the taphonomic data, the manifestations of taphonomic processes on the bones, are discussed. Finally, the important bone bearing contexts on site are examined in order to ascertain whether any patterns of structured deposition of animal bone material could be detected. The definition of "important bone bearing contexts" is taken as contexts recognised as containing bones during excavation, together with contexts such as pits under house floors that have been found to contain significant deposits in other Atlantic Scotland sites. The chapter conclusion sums up the findings and the results will be discussed further, together with the results from Beirgh, in Chapter 6.

4.1 The species retrieved and their relative abundance

4.1.1 The species retrieved

The following mammalian species were identified in the assemblage of animal bones retrieved from the excavations at Bostadh: cattle (*Bos taurus* L.), dog (*Canis familiaris* L.), goat (*Capra hircus* L.), grey seal (*Halichoerus grypus* Fabricius, 1759), horse (*Equus cabullus* L.), otter (*Lutra lutra* L.), pig (*Sus scrofa* L.), pine marten (*Martes martes* Pinel 1792), red deer (*Cervus elaphus* L.) and sheep (*Ovis aries* L.). Henceforth these taxa will be referred to by their British common names. Table 4.1 below illustrates the species present in each phase of occupation of the site.

Table 4.1a the species present in the Bostadh assemblage

species	Phase 1	Phase 2	Phase 3	Phase 4
cattle	***	***	***	***
dog	-	*	-	?
goat	*	*	-	*
grey seal	*	*	-	*
horse	*	**	*	**
otter	*	**	*	**
pig	-	*	*	**
pine marten	-	-	-	*
red deer	**	**	***	***
sheep	**	**	**	**

Key

Number of fragments retrieved (NISP)

- - no fragments retrieved
? - 1 questionable fragment
*** - scarce (1 – 9)**
**** - common (10 – 99)**
***** - abundant (100 – 1000)**

It can be seen from Table 4.1 that cattle are the most abundant species represented in the animal bone assemblage. In the assemblages retrieved from Phases 3 and 4 red deer bones are also abundant and sheep bones are common throughout all phases. Sheep are probably under-represented as some bones could only be identified as "sheep/goat". Pig is present in Phases 2, 3 and 4 and there is no reason to suspect the remains derive from wild boar. Dog is only definitely present in Phase 2. Horse is present in all four phases but represented by few bones. Phase 4, the Norse occupation phase, has the biggest number of species and Phase 3 the smallest number. Otter bones are present in contexts throughout all four phases and one pine marten bone was present in a context from Phase 4. Goat is present in contexts from Phase 1, 2 and 4, though represented by small numbers of bones.

4.1.2 Quantification

For the reasons outlined in 3.1.8 the number of identifiable specimens (NISP), minimum number of individuals (MNI) and bone weight, have all been calculated.

Table 4.1b NISP figures for the Bostadh assemblage

species	Phase 1	Phase 2	Phase 3	Phase 4
cattle	102	153	270	175
sheep / goat	118	199	198	133
red deer	29	68	139	157
horse	5	55	5	17
otter	3	14	2	22
grey seal	1	7	0	2
pig	0	2	4	10
pine marten	0	0	0	1
goat	0	2	0	1
dog	0	1	0	1?

Table 4.1c lists the NISP for the mammal, bird and marine resources retrieved from Bostadh and Beirgh. Where no figure is present it means that the NISP was not calculated, usually because the method of phasing used had been different from that used by the current writer.

Table 4.1c: NISP figures for all bone and shell retrieved from Bostadh and Beirgh

	Bostadh Phase 1	Bostadh Phase 2	Bostadh Phase 3	Bostadh Phase 4	Beirgh
cattle	102	153	270	175	906
sheep / goat	118	199	198	133	317
red deer	29	68	139	157	609
horse	5	55	5	17	5
otter	3	14	2	22	4
grey seal	1	7	0	2	8
pig	0	2	4	10	43
pine marten	0	0	0	1	0
goat	0	2	0	1	0
dog	0	1	0	1?	0
Total bird	19	12	119	8	
Total fish	86	14399	7763	1013	
Total shellfish	144	46090		308	

The calculation methods employed to derive secondary data, in particular the method used for calculating MNI, vary greatly between workers, so must be explained in detail if the results are to be in any way comparable with those obtained elsewhere. Therefore, the MNI calculation method used is detailed in 3.2.8.3. The MNI figures are presented in Table 4.2.

Table 4.2: - MNI figures for Bostadh

	Phase 1		Phase 2	
	MNI	**Element (s)**	**MNI**	**Element(s)**
Cattle	5	L mc	6	R ast, L mn
Red deer	2	R hu	5	R ast
Dog	0		1	L M1
Goat	1	L ra	1	L & R mn
Horse	1	R ast, L cal, L mn, R mt	2	L mn, L sc
Grey seal	1	ep	2	L pe
Otter	2	L mn	2	L & R mn, L tb
Sheep/goat	3	R cal, L hu, R ra	7	R mn
Pine marten	0		0	
Pig	0		1	Max mlr

	Phase 3		Phase 4	
	MNI	**Element (s)**	**MNI**	**Element (s)**
Cattle	10	R mc	5	L ast, R mn, R ra
Red deer	5	L ast, L cal, R hu, L&R tb	7	L pe
Dog	0		0	
Goat	0		1	L mn
Horse	1	L mcIV, R. mn, L. ra.	2	R mc II - III
Grey seal	0		1	R pe
Otter	1	L hu, L mn	3	R mn
Sheep/goat	6	R cal	7	R mn
Pine marten	0		1	R mn
Pig	1	R fe, L mn, L ra	1	L dp4, R mn, L ra, L tb

Key to Table
L – left

R – right
ast – astragalus
cal – calcaneum
dp4 – 4th deciduous premolar
ep – epistropheus (atlas)

fe – femur
hu – humerus

fe – femur
Max – maxillary
mc – metacarpal
mlr – molar
mn – mandible

mt – metatarsal
M1 – first mandibular molar
pe – pelvis
ra – radius
sc – scapula
tb – tibia

Table 4.2 illustrates that the MNI figures for all species are small throughout all phases. The figures reflect the small assemblage size; they must not be interpreted as having any relationship to the quantities of animals present on site during the occupation phases. The MNI figures are presented to provide a rough guide to presence/absence of the various mammalian taxa in the assemblages from the four phases, and to allow trends to be detected. Cattle, sheep/goat and red deer are the most abundant taxa. The rarer taxa, goat, grey seal, pine marten and otter are over-represented, relative to the more abundant taxa, in this quantification method. Pig is represented from Phase 2 onwards. The number of red deer appears to increase through time. There is no concomitant decrease in numbers of other abundant taxa, sheep/goat and cattle, over time.

With the NISP data, an effort has been made to differentiate between primary and secondary data (O'Connor 1985) and both are presented in graph form. Due to the relatively small size of the assemblage, particularly the small number of bones retrieved from Phase 1, the NISP quantification data will, like the MNI data, also be most useful for detecting trends and change over time. To avoid repetition, this caveat will not be stressed after each statement made, but it should be borne in mind throughout this chapter.

Figures 4.1 to 4.4 show the relative proportions of each species, in each phase, quantified both by weight and by NISP. Three categories are included in the figures. The first, representing primary data and thus labelled as "primary", shows the number of specimens that were identified to a single taxon, e.g. sheep, pig, goat or red deer. The second set of charts, labelled "sheep/goat" includes those bone fragments that were identified as "sheep/goat adjusted", which have been assigned to either "sheep" or "goat" as explained above (3.2.8.2). The third set of charts, called "adjusted", include all specimens identified to a range of taxa and subsequently assigned to each species according to their relative abundance. All figures show that the weight method emphasises the larger-bodied taxa relative to the smaller ones. When the relative proportion of any taxon was less than one percent it was omitted from the graph, which explains the variation in the number of taxa represented in each graph within each figure.

It can be seen that after allocating the sheep/goat bones to sheep or goat the further allocation to taxon of bones from categories such as "large ruminant" makes little difference to the relative proportions of species (in both NISP and weight quantification methods). This is partly explained by the fact that relatively few specimens could only be identified to a range of species, and partly by the fact that those that did exist were allocated to particular taxa according to the relative abundance of the various species in their size category. Hence, the relative proportions of each species present will be the main influence on the adjusted figures. Both categories are shown since they are both secondary data and they represent different modifications of the primary data. The second category, which has been adjusted for sheep/goat, will vary less between workers since some elements cannot be distinguished readily between sheep and goat (Boessneck 1969), regardless of the expertise of the analyst. The third category will vary more, since workers differ in their belief in the security of their identifications; in their ability to identify specimens; and in how they treat less-readily identifiable specimens; all of which will affect the relative proportions of the taxa in the third category of (adjusted) data. Therefore, all three data categories have been shown. The degree of modification of the figures can be judged by the number following the name of the calculated taxon, e.g. "sheep 2" has been modified once to include the reassessed sheep/goat (sheep/goat) bones. Taxon "sheep 4" has been modified three times to include a proportion of the bones classified to the level of small ruminants and medium mammal.

Figure 4.1 indicates that cattle are the most relatively abundant species in Phase 1, when the weight of bones is the quantification method used, while sheep are relatively more abundant when the NISP is calculated and the sheep/goat bones are accounted for. Red deer and horse are also relatively abundant and grey seal and otter are present but relatively rare in the assemblage from this phase. While some of these species may not represent food animals it does appear that cattle and sheep are the most abundant species in this assemblage, which may indicate their relative economic importance during the occupation in Phase 1.

Figure 4.2 illustrates that cattle and sheep/goat, again, are the most abundant species present in the Phase 2 assemblage, from the NISP figures. Bone weight, again, suggests cattle are proportionately more important in Phase 2, and bone weight is likely to be roughly equivalent to meat weight (in animals, such as these, which are not vastly different in size). It can therefore be proposed that cattle were the most economically important species present during Phase 2. Red deer are present in reasonable quantities, varying from 14 – 18% depending on the data type and quantification method used.

In Figure 4.3 it can be seen that red deer are relatively more abundant in the assemblage derived from Phase 3 than they were in Phases 1 and 2. Cattle remain the most abundant species when quantified by weight. Red deer increase in relative abundance to between 21 - 29% depending on the method of quantification used.

Figure 4.4 shows red deer comprising proportionately more of the assemblage than in any of the previous phases suggesting the increasing relative importance of red deer in the assemblage through time. In Phase 4, the Norse phase, red deer are approximately one third of the assemblage regardless of the quantification method used. The proportion of red deer increases throughout the four phases in each category of data presented; in Phase 1 red deer comprise 9 – 12% of the assemblage; in Phase 2 they increase to 14 – 18%; in Phase 3, 21 – 29%; and in Phase 4 rise to 28 – 37%. Compared to the figures for cattle and sheep this shows remarkable consistency and may therefore suggest there was a trend towards increasing exploitation of the animals over time.

In the NISP graphs for Phase 4 (Figure 4.4) it can be seen that the relative proportions of sheep/goat decrease compared to all the previous phases, but particularly relative to Phase 3. The relative proportion of sheep/goat bones, quantified by weight, does not show such a consistent decrease, actually increasing between Phase 3 and Phase 4, suggesting that the perceived decrease in the relative proportion of sheep/goat may not be real.

If the retrieved assemblage is roughly representative of the death assemblage then the data suggest a greater exploitation of red deer, proportional to sheep/goat and cattle, during Phase 4 than in the previous phases, which may reflect different economic strategies and / or changes in husbandry practices over time. It is particularly notable that the relative greater abundance of red deer in the assemblages increases during Phase 3 and 4, the "transition" and Norse phases, possibly reflecting a variation in cultural practice being reflected in the bone assemblage.

Calculation of the relative abundance of any one taxon will be affected by the other taxa present in the assemblage, as an increase in relative abundance of one taxon must result in the concomitant decrease of another. In small assemblages, the presence of a restricted number of animal bones can skew the results considerably, as can be seen in the case of horse in Phase 2. Horse bones comprise a larger part of the assemblage in this phase than in the others, resulting in the relative importance of cattle appearing to decrease from Phase 1 to Phase 2, then increase again between Phase 2 and Phase 3. As it is possible that these species fulfilled different economic roles (horses may not have been eaten for instance) this apparent change in the importance of cattle may be illusory. Further information on the taxa must be derived in order to explore this question further, for example the ages at death of the two species might indicate whether they were meat animals or used for another purpose, such as traction.

Although the relative proportions of species data are a useful way of revealing possible trends the actual figures are also important and they are given in Figures 4.5 – 4.7 (NISP) and 4.8 – 4.10 (weight). The graphs indicate that the number of red deer specimens increased throughout the four occupation phases in absolute terms, both in NISP and in bone weight, so it can be assumed that the economic importance of red deer increased through time, as discussed above.

Figures 4.5 – 4.10 shows that the number of taxa present in each phase varies from six in Phase 3 through to nine in Phases 2 and 4. A test was done to see whether the variation in the number of species present in each assemblage was a factor of sample size. It was discovered that there was no correlation (see Figure 4.10b).

Cattle, sheep, red deer, horse, pig and otter occur in all four phases and grey seal is present in all phases except Phase 3. The remaining species are present in only very small quantities so must be considered as exotics; they include one dog bone in Phase 2 and one pine marten mandible in Phase 4. A distal radius epiphysis from goat is present in Phase 1, two complete goat mandibles were retrieved from Phase 2 and a mandible fragment (including the tooth row) was present in Phase 4. The presence of the greatest number of exotic species in Phase 4 may reflect economic diversification by the Norse, either in the species farmed or hunted, or it may reflect trading links with external sites. However, it would be unwise to argue strongly for Norse diversification based on such a small number of exotic bone fragments alone.

The pine marten was represented by a complete mandible, which could have been on site because it had been attached to a pelt. It is unclear whether pine marten were ever present in the Western Isles. One was reported in Raasay, one of the Inner Hebrides, in 1971 (Knowlton 1977, 35), and there is anecdotal evidence from Harris of a pine-marten and sheep being found dead together, with the teeth of the pine marten embedded in the neck of the sheep (Knowlton 1977, 162). Such a (possibly apocryphal) tale cannot be interpreted as evidence for a thriving population of pine-martens on the island in the recent past, let alone the Late Iron Age. Only the one bone was identified as pine marten, a confident identification supported by another worker. Since a mandible could have easily been left attached to a traded pelt, the pine marten bone lends itself more to speculation about trading and cultural links than to biogeographical or environmental speculation. As the pine marten bone was retrieved from a context in Phase 4 it may have been taken from Scandinavia by the Norse, or it may reflect trading with Scandinavia or mainland Scotland by the Norse whose seafaring abilities are well known (e.g. Graham-Campbell and Batey 1998; Owen 1999; Jones 1964; Pálsson and Edwards 1978). Indeed the very term "Viking" by which they are popularly known stems from the Old Norse noun *víkingar* meaning bands of men who raid from boats (Byock 2001, 12).

Otters appear to be present in all phases, albeit in negligible quantities in Phases 1 and 3, which might represent intrusive bones. The only butchered otter bones on the site are in Phase 4 suggesting that the otter specimens, in the other phases, may have derived from otters dying *in situ* in abandoned buildings. The fourteen otter bones from Phase 2 derive from a minimum of two individuals, increasing the plausibility of this hypothesis because two individuals could easily have died *in situ* within the buildings at any time since the occupation period. There are at least two otters present in the assemblage from Phase 1 also, one in Phase 3, and 3 in Phase 4. All otter MNIs are calculated on the minimum number of mandibles present, as they were the most abundant element retrieved among the otter bones. While the mandibles could have been introduced to the site on imported skins, as speculated for the pine marten mandible, sufficient post-cranial otter bones were retrieved to indicate that this was not the case. Four bones from otter, all from contexts within Phase 4, were butchered. Two of the butchered bones were femurs; one was a humerus and one a mandible. The long bones displayed marks on the distal ends, as would be expected if the animals had been skinned. Knife marks on the mandible are consistent with this hypothesis also. One of the butchered femurs derived from an immature animal, as both epiphyses were unfused. The unfused otter bones present were all almost fully-grown, late-fusing bones such as the femur and tibia. The otter bone evidence suggests the Norse were making use of otter skins. Although there is no evidence of otter skinning in earlier phases, it may be unwise to argue from absence of evidence, particularly when so few bones are involved.

No cat bones were identified in either of the assemblages (hand retrieved and sample processed) studied by the author. Four bones from immature cat were present among the hand retrieved bird bones (O'Sullivan 1997). Described as "slightly eroded" the bones derived from four different contexts and could represent intrusions. It is unlikely that cat was not present on the site. Rodent bones were rare, around sixty post-cranial bones being retrieved from the sample processed material, mainly rat sized. It seems probable that mice and voles would be present, so the lack of bones may be due to taphonomy. The bones might have been crushed underfoot or between boulders; they might have been removed by percolating groundwater, or they might have not been picked up in the sample processing. There is not much sign of rodent gnawing on the fragments, certainly not in comparison to medieval assemblages the author has worked on, so it is possible that they were scarce around the site during the time it was occupied. An almost complete skeleton of a wood mouse (*Apodemus* spp.) was discovered during underwater excavation at Dun Bharabhat (N. Dixon pers. comm.), testifying to the excellent preservation and recovery possible with underwater excavation.

Eleven pig bones were retrieved from the excavations at Bostadh, seven of which were from the skull; mandible fragments and maxillary molars and a premolar. None of the pig bones displayed any butchery marks, but four of the retrieved bones were teeth, which would be unlikely to be butchered, and indeed would be resistant to cutting or marking by a blade if they were. Only one fragment had any fusion information, a fused distal humerus, which fuses when the animal is around one year old. Two mandible fragments displayed dental attrition data. One had the first molar at Grant's wear stage "d", the second molar at stage "b" and the deciduous premolar at stage "g"(Grant 1982) indicating a young animal. The other was an older individual with the fourth premolar erupted and in wear. As this tooth erupts at between 12 and 16 months (Hillson 1986, 209) this individual must be in at least its second year of life. The first two mandibular molars are at Grant's (1982) wear stages "j" and "e" respectively, well worn teeth indicating a mature animal. As pigs are not generally considered to be kept for secondary products this most likely represents an animal retained for breeding purposes. The mandibles were both found in Phase 3 midden deposits in House 1 (Contexts 98 and 99). Three maxillary molars were also present in the assemblage and two of them and a maxillary premolar (in wear), were from context 129, which is described as windblown sand, from House 3, Phase 4. The presence of pig teeth might suggest the context was a floor level or the result of sweeping the floor, rather than a layer of windblown sand. One well-worn maxillary pig molar was retrieved from Context 148, a floor level from House 3, Phase 2. Therefore, there is evidence of mature, breeding pigs on site from Phases 2, 3 and 4.

Ten grey seal bones were present in the assemblage; only the single bone retrieved from a context in Phase 1, an epistropheus, displayed any butchery marks. Only one mandible was retrieved from the site. The mandible, a left pelvis, a left radius, a left scapula and left femur were retrieved from deposits dating from Phase 2, contexts 363 and 364, both wall core contexts from the east wall of House 3. It is therefore possible that they might represent seal remains present in the sand within the wall and as such they may not necessarily be of anthropogenic origin.

Figures 4.8 to 4.10 indicate the weights of bone retrieved from each species from each phase. The logarithmic scale used allows the depiction of very small and very large numbers together in one graph, but also diminishes the difference between them. Several points of interest emerge from these figures. Arguably, most importantly, the weights are very small, the largest being just over five kilos for cattle bones retrieved in Phase 3. Such a figure obviously represents a correspondingly small quantity of meat, particularly if an occupation phase is considered to last a hundred years or more. Hence, the huge taphonomic loss of bone that has taken place on the site can be appreciated.

The scarcity of goat bone is emphasised by the fact that a greater weight of (the much smaller and lighter) otter bone was retrieved than goat bone. The goat bones should be shown to another zooarchaeologist for confirmation before publication. Horse appears to be very abundant when quantified by weight; this may be due to the horse bones being denser than those of other animals, which might indicate the animals were more mature at death than were the other species. Alternatively, the greater density of the horse bones might have favoured their survival in contexts where other bones were destroyed. The apparent abundance of horse in these three figures demonstrates one of the drawbacks of the weight method of quantification, and illustrates the advantage of quantifying an assemblage in more than one way. Figure 4.8 indicates that horse appears to be almost as abundant as cattle (the most abundant species) in Phase 2. However Figure 4.5 indicates that in Phase 2 there were fifty-five horse specimens and 153 cattle specimens retrieved. Further, it can be seen from Table 4.2 that the horse specimens could have all derived from two individuals, while the MNI for cattle was six.

The use of a logarithmic scale masks the effect somewhat, but it is obvious from Figures 4.8 to 4.10 how dominant cattle bone is in all assemblages, with only red deer nearing it in abundance in Phases 3 and 4. Although some of the abundance may be due to taphonomic factors militating against the preservation of the smaller mammals, particularly sheep, it does appear that cattle have been important in the diet throughout the occupation of Bostadh.

4.2 Body part representation

4.2.1 Were animals brought onto site as carcasses or jointed body parts?

A simple test was run to find out whether an assumption could justifiably be made that the animals were most likely to have arrived on site as complete carcasses, rather than as jointed body parts. The test consisted of simply quantifying the fore and hind limb bone fragments retrieved from each of the main three taxonomic groups (cattle, sheep/goat and red deer), for each occupation phase and for the site as a whole. Four large elements from each limb were selected for this exercise. While this test is crude and takes no account of fragmentation patterns, the biological and physical similarity of the fore and hind limbs, together with the selection of broadly similar representative bones from each, go some way to counteracting this. It can be anticipated that fracture patterns and taphonomic effects will be broadly similar for each limb; long bones such as metapodials being resilient, flatter bones such as the pelvis and scapula being less so. A count based on the MNE (minimum number of elements, see 3.2.10) was also carried out to lessen the possible effect of differential fragmentation. The elements selected as representing the forelimb were the scapula, humerus, radius, and metacarpal. The pelvis, femur, tibia and metatarsal represented the hind limb. The three taxa (cattle, sheep/goat and red deer) have the same number of each element in their skeletons. Tables 4.3 to 4.5 show the numbers of bone fragments retrieved, quantified both as NISP and as minimum number of elements. No statistical tests were used to quantify and test the significance of these results due to the crude nature of this initial test and the concomitant danger of attributing specious authority to a basic fragment count.

Table 4.3: limb representation for cattle (NISP)

Phase	1		2		3		4	
	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE
Fore limb (sc, hu, ra, mc)	21	12	28	14	31	10	34	16
Hind limb (pe, fe, tb, mt)	26	15	31	13	60	24	48	18

Key

sc – scapula	**ra – radius**	**pe – pelvis**	**tb – tibia**
hu – humerus	**mc – metacarpal**	**fe – femur**	**mt - metatarsal**

Table 4.3 illustrates that in the case of cattle the limbs are represented roughly equally in Phases 1 and 2, then, in Phase 3, hindquarters are about twice as common as forequarters, with both quantification methods. In Phase 4 the hindquarters predominate slightly, but the discrepancies in the figures are small enough to be ignored, particularly when the MNE figures are considered. In general, cattle appear to have been brought onto site whole, rather than in butchered segments. Phase 3 may be different, and the figures may be indicating some export, or import, of quarters of beef.

Table 4.4: limb representation for sheep/goat (NISP)

Phase	1		2		3		4	
	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE
Fore limb (sc, hu, ra, mc)	37	19	47	22	33	21	22	19
Hind limb (pe, fe, tb, mt)	34	17	47	24	44	19	40	26

Key

sc – scapula	**ra – radius**	**pe – pelvis**	**tb – tibia**
hu – humerus	**mc – metacarpal**	**fe – femur**	**mt - metatarsal**

The data for limb representation figures for sheep/goat are displayed on Table 4.4. Sheep/goat limbs are present in roughly equal numbers in Phases 1 and 2, then hindquarters predominate slightly, in the NISP figures at least, in Phase 3 and then both figures indicate the preponderance of hindquarters in Phase 4. The MNE figures in particular emphasise the small size of the assemblage. The biggest difference in MNE figures, in Phase 4, is only seven, which may represent only two extra haunches. Thus it appears that the hypothesis that sheep/goat were introduced as whole carcasses, or live animals, onto site throughout the four occupation phases can be accepted.

Table 4.5: limb representation for red deer (NISP)

Phase	1 & 2		3		4	
	NISP	MNE	NISP	MNE	NISP	MNE
Fore limb (sc, hu, ra, mc)	25	10	29	19	21	12
Hind limb (pe, fe, tb, mt)	32	9	37	14	75	34

Key

sc – scapula	**ra – radius**	**pe – pelvis**	**tb – tibia**
hu – humerus	**mc – metacarpal**	**fe – femur**	**mt - metatarsal**

Red deer are present only in small numbers in Phases 1 and 2, so the figures have been combined in Table 4.5 and show that forelimbs and hind limbs are present in roughly equal numbers. While this has little archaeological meaning, it was thought to be preferable to ignoring red deer limb representation for the two phases completely. For the assemblage retrieved from contexts in Phase 3 the numbers are again similar, with forequarters being slightly predominant when the MNE is calculated. For the bones in the Phase 4 assemblage however, the hindquarters appear to predominate, being approximately three times more abundant than are the forequarters. This may indicate a change from the introduction of whole animals to the site at this time.

For most taxa through most phases the evidence seems to suggest that the animals were introduced whole to the site, whether alive or dead. Two exceptions are for cattle in Phase 3 and red deer in Phase 4; where, in both cases, the hindquarters are more abundant. One cultural circumstance that might lead to a preponderance of hind limbs would be if the people on the site were importing hindquarters of meat from outside, or exporting forequarters out of the site, that is, if there was trading with other sites.

4.2.2 Was the site at Bostadh a producer or a consumer site?

A similar count to the one done for limb representation was carried out to ascertain whether there was any evidence for the site at Bostadh having been either a producer or a consumer site. This was explored by studying the types of body part most heavily represented on the site, working on the assumption that a site where carcasses were being butchered for consumption elsewhere (a producer site) would have an animal bone assemblage dominated by "waste products". Bones with a low meat yielding value, such as the phalanges, carpals, metapodials and skulls would be expected to dominate in such an assemblage. Conversely, the assemblage from a (consumer) site that was importing prepared meat joints would be expected to have proportionately fewer of these low meat yielding bones and to be dominated by higher meat yielding elements like the humerus, femur, pelvis, scapula, radius, ulna and tibia. In order to test the hypothesis that no such bias is present in the assemblage the various parts of the carcass were divided into low and high meat yielding bones and counted again. Metapodials, which were often valued in prehistory for bone working purposes, have been omitted from this calculation, as have elements less readily identifiable to species, such as ribs and vertebrae. The count performed was of the minimum number of elements, no account being taken of side or maturity (see 3.2.10).

Table 4.6: Meat yield figures for cattle (MNE)

CATTLE	Phase 1	Phase 2	Phase 3	Phase 4
High meat yielding Pe, sc, hu, fe, tb, ra,	17	17	14	27
Low meat yielding Mn, cal, ast, pph/4, mph/4, dph/4	17	33	43	26

Key

ast - astragalus	**hu – humerus**	**pph - proximal phalanx**
cal - calcaneum	**mn – mandible**	**ra – radius**
dph - distal phalanx	**mph – middle phalanx**	**sc – scapula**
fe – femur	**pe – pelvis**	**tb – tibia**

Table 4.6 shows that there are roughly equal numbers of high and low meat-yielding elements of cattle in the assemblages in Phases 1 and 4. If this is interpreted as meaning that there is no evidence of preparation of meat for export, or of the import of meat from outside the site then the evidence supports the limb representation evidence above. In Phases 2 and 3 however, the evidence is different with low meat yielding bones dominating the assemblages, possibly indicating evidence of butchery and export of prepared meat joints from the site. Of course there are other possible explanations, including the potential greater bone loss in cooked bones, which, particularly in larger taxa, may have been chopped up to

fit into a cooking vessel or similarly destroyed during consumption of the meat. The greater fragmentation incurred may have rendered the bones less robust and so less likely to survive, or they may have survived equally well, but in such a fragmented condition as to be unidentifiable to species. For whatever reason, the results from Phase 3 appear to be different, as they did with the limb representation calculations.

Table 4.7: Meat yield figures for sheep/goat (MNE)

SHEEP/GOAT	Phase 1	Phase 2	Phase 3	Phase 4
High meat yielding Pe, sc, hu, fe, tb, ra,	22	32	35	34
Low meat yielding Mn, cal, ast, pph/4, mph/4, dph/4	17	33	34	21

Key

ast - astragalus	**hu – humerus**	**pph - proximal phalanx**
cal - calcaneum	**mn – mandible**	**ra – radius**
dph - distal phalanx	**mph – middle phalanx**	**sc – scapula**
fe – femur	**pe – pelvis**	**tb – tibia**

Table 4.7 indicates that the numbers of low and high meat yielding bones from sheep/goat are approximately equal through Phases 1 to 3, while Phase 4 has a preponderance of high meat yielding bones. The greater number of meat yielding bones may indicate prepared mutton was imported, but again the small numbers militate against making such an assumption. Other cultural causes can be envisaged, such as the feeding of butchery waste to dogs or the use of the small foot bones for some other purpose such as toys or personal adornment. Most of the low meat-yielding bones are small bones of the foot and leg and, particularly in smaller animals, may be relatively poorly represented in the retrieved assemblage even when sieving has not taken place. A host of taphonomic factors may have acted against the survival of the smaller bones of the foot so there is no reason to reject the hypothesis that sheep/goat were introduced to the site whole, on the evidence presented.

In the case of red deer (Table 4.8) there are roughly equal quantities of high and low meat bearing bones in combined Phases 1 & 2 and in Phase 3, but as with the figures above for limb distribution (Table 4.5), there may be evidence for something different in Phase 4. Higher meat yielding bones outnumber the lower meat yielding bones in the assemblage of identifiable retrieved specimens. If the deer are being obtained some distance from the site the result may indicate that the heads and lower legs are being removed to lessen the weight carried home. Alternatively, cultural change in the use made of the foot bones may have occurred, resulting in less of them being thrown away as waste. Similarly, perthotaxic, taphic or anataxic taphonomic factors may have caused the comparative lack of the smaller bones.

Table 4.8: Meat yield figures for red deer (MNE)

RED DEER	Phases 1 and 2	Phase 3	Phase 4
High meat yielding Pe, sc, hu, fe, tb, ra,	14	24	38
Low meat yielding Mn, cal, ast, pph/4, mph/4, dph/4	15	27	18

Key

ast - astragalus	**hu – humerus**	**pph - proximal phalanx**
cal - calcaneum	**mn – mandible**	**ra – radius**
dph - distal phalanx	**mph – middle phalanx**	**sc – scapula**
fe – femur	**pe – pelvis**	**tb – tibia**

At Bostadh the excavations took place over one year and retrieval methods were consistent throughout the excavation seasons (Church 2002). It can be assumed that any sullegic processes, such as smaller bones being missed during excavation, or being incorrectly identified at the analysis stage, will be constant over the assemblages from all four phases.

Hence, sullegic processes are not likely to be the explanation for any of the above discrepancies in numbers.

For subsequent element distribution analysis the assumption is made that the animals were brought onto site live or as complete carcasses as this appears to generally be the case, with the possible exceptions of red deer in Phase 4 and cattle in Phase 3.

4.3 Element distribution

4.3.1 Quantification of elements

In the following element distribution analysis, account was taken of the fact that long bones are more likely to end up fractured as a result of taphonomic processes than are squarer, shorter, more compact bones. For this reason, another count of long bones was made. The ends of the bones were counted, as described in 3.2.9 above, reflecting the fact that bones are more likely to end up in the assemblage in a fractured state, and also that the epiphyseal ends are more identifiable than the middle parts of the diaphyses, due to their articulating surfaces.

4.3.2 Element distribution for cattle, sheep/goat and red deer

Figures 4.11 to 4.13 portray the element distribution for cattle, sheep/goat and red deer and the figures on which these graphs are based are given in Appendix 4.1. Figures 4.11 to 4.13 indicate that there is considerable variation, both between species and between phases, in which elements are most abundant. The colour coding indicates the various body parts that might be expected to occur together, since they are near each other in the skeleton, and reflects something of the utility of the skeletal elements. For example the bones of the foot, the proximal, middle and distal phalanges, are coloured yellow. Such bones bear little meat and a preponderance of them in an assemblage might be interpreted as an indication of a producer site where butchery and the production of jointed pieces of meat for export off site occurred. A producer site would deposit comparatively large quantities of low-meat bearing bones such as skulls and feet. A complicating factor is the fact that the phalanges are small, dense, compact and distinctive bones, unlikely to be broken up into unidentifiable fragments, so will be comparatively common in an assemblage anyway, particularly when sieving has been done.

A consumer site would be expected to show proportionately higher quantities of high meat-bearing elements such as the humerus, scapula and radius in the deposited assemblage. High meat-bearing elements might be imported onto site as a jointed piece of carcass, such as the shoulder or haunch, in which case the high meat-bearing elements would be noticeably more common than other elements. Again, complications of equifinality arise, whereby the processes of food preparation might render the bones unidentifiable through fragmentation at the cooking or eating stage. Marrow extraction and the action of carnivores such as dogs are two processes particularly liable to result in unidentifiable bone fragments.

Figure 4.11 demonstrates that, for cattle, there appears to be a change over time in the elements that are more abundant. During Phase 1 the foot and head bones are relatively poorly represented and the hind limb bones are over represented compared to what would be expected if the elements were equally represented. The sample size is, however, particularly small at 69 elements. In Phase 2 no pattern is obvious with bones from the head and feet (low meat bearing) being interspersed with the higher meat bearing bones throughout the graph. The most abundant skeletal parts in Phase 2 are the astragalus, mandible and calcaneum, all compact, structurally dense bones, suggesting that differential survival may be the cause of the pattern observed. Perhaps surprisingly, the distal humerus, a compact, structurally dense, readily recognisable bone is not well represented in this sample.

However, the small sample size means that very small variations in numbers of retrieved bone will have a great effect on the results obtained. Phase 3 has a somewhat larger sample size and the three phalanges are notably over-represented. The metacarpal is also highly represented, as is the astragalus. As stated previously the metapodials are complicating factors, due to their usefulness as raw material for tool manufacture, but they and the other highly represented bones, are all of the foot and lower leg, which could represent butchery waste. Another small sample from Phase 4 shows a reasonably even spread of element representation, with the astragalus and mandible being slightly over-represented and the distal phalanx, the distal humerus and proximal metatarsal being under-represented. Once again the data suggest something different happening with cattle in Phase 3 the Late Iron Age / Norse transition phase.

Figure 4.12 illustrates the element representation for sheep/goat and, once more, the sample numbers are small. Mandibles are consistently highly represented throughout all four phases and the phalanges tend to be under-represented probably due to their small size. The more dense and compact elements seem to have survived better, suggesting that physical taphonomic forces may have acted on the assemblage.

Figure 4.13, the red deer element representation, also has very small sample sizes. No pattern of predominance is noticeable in the first graph, which is an amalgamation of Phases 1 and 2. Throughout Phase 3 and 4 the hind limbs seem to be more abundant, including the proximal tibia, an element that is not very structurally strong. However, due to the small sample size this may just represent some complete tibiae in the sample. Mandibles and metapodials are not under-represented and the astragalus and calcaneum are over-represented in Phases 1 and 2 and in Phase 3. The evidence points to whole carcasses being present on the site, rather than body parts being introduced, during Phases 1 to 3. Phase 4 may be different, as hypothesised earlier, since there is a predominance of hind limbs and the lower limb bones are under-represented.

4.3.3 Element representation – comparison between taxa

If the element representation was primarily a result of preferential preservation, the more durable and tougher bones resisting destruction by natural or anthropogenic forces, then it might be expected that the same bone fragments would be preserved regardless of the species. It might particularly be expected that bone fragments from taxa of broadly similar size would show similar element representation patterns. Figure 4.14 illustrates the element representation of both cattle and red deer from phases 3 and 4, the two phases where red deer specimens occur in reasonable quantities (>100). The elements are listed on the charts in the order of abundance that they occur for cattle in the phase in question; the most abundant skeletal zones are on the left side of the graph. It can be seen that there is little or no correlation between the abundance of skeletal zones in red deer and cattle, with some skeletal zones, such as the astragalus, calcaneum and distal tibia, being relatively more highly represented in red deer in phase 3. In these skeletal zones O/E is greater than 2, hence they are more than twice as common as expected, if all elements were equally distributed, while in cattle in phase 3 the tibia and calcaneum is less abundant than expected (O/E < 1). The over-representation of small bones such as the astragalus and calcaneum in red deer may be due to them being comparatively more dense and compact than are the equivalent elements in the cattle skeleton. However, the higher proportions of phalanges in cattle than in deer, in Phases 3 and 4, argue against this and an alternative explanation might be that the larger cattle bones were more fragmented during cooking and consumption than were the deer bones. In addition, the relatively high frequencies of these smaller bones reflect the fact that sieving took place on site, and, therefore, that the discrepancies in relative frequencies between species is unlikely to be caused by sullegic processes such as the non-retrieval of smaller bones.

Figure 4.15 demonstrates that the element distribution in cattle and sheep/goat is also different, with sheep/goat mandibles being relatively much more abundant in Phase 3 than are those of cattle. Other differences include the under-representation of phalanges in the sheep/goat compared to cattle in both phases and the relative over-representation of the distal humerus in sheep/goat. The lack of phalanges may reflect retrieval taphonomy, but the relatively high representation of sheep/goat calcaneum and astragalus bones suggests otherwise, as they are a similar size to the phalanges.

It can be seen from Figure 4.16 that the element representation of sheep/goat and red deer seems to show more correlation than do the other diagrams, with high O/E values for distal tibia, astragalus, calcaneum and distal humerus in both taxa in Phase 3. The similarities may be caused by similar butchery and cooking practices, or by roughly equivalent bone densities in the two taxa, resulting in equal survival of these particular skeletal zones.

Figure 4.17 displays the O/E values for the three main taxa, arranged in order of abundance for cattle and demonstrates the lack of correlation in the figures suggesting that the taphonomic processes operating on the bone fragments are different for these three taxa.

4.3.4 The effect of bone structural density on element representation

It can be seen from Figures 4.14 to 4.17 that certain skeletal zones appear to be frequently included among the zones that are highly represented, particularly the astragalus, calcaneum, distal tibia and distal humerus. As these bones are dense and compact their relative abundance, together with the fact that they are comparatively more abundant in the smaller taxa (red deer and sheep/goat) suggests that bone density may be an influencing factor.

To test the hypothesis that bone structural density may be an important factor in influencing the element representation the skeletal zones were graphed in order of structural density with the most dense to the left. The exercise was only done for the sheep/goat bones as at the time this analysis was carried out no published photo absorptiometry figures for red deer or cattle were available. The decision was made not to use the published figures for caribou and bison which were available (Lyman 1994) since caribou and bison are morphologically quite different from red deer and cattle respectively, so it is probable that the structural densities of their bones would vary also. Published figures for cattle became available towards the end of the research period and were tested on the larger sample of cattle bones from Beirgh (see 5.3.4).

In order to carry out this exercise the sheep structural density figures (Lyman 1994, 246 – 7) had to be modified. Photon absorptiometry readings from "scan sites" were provided (Lyman 1994, 241), while the analysis required figures that would relate to the fragments of elements quantified for previous analyses of element distribution. The figures were arrived at by taking the lowest reading given for any skeletal zone, such as the distal humerus. This was based on the assumption that the "weakest link" theory would apply and the survival of any bone fragment would be determined by the smallest figure given for structural density. Hence, the skeletal zones were arranged along the x-axis, from left to right, according to their decreasing structural density on this basis. If the element distribution reflects structural density then it would be expected that the curve of the graph depicting element abundance for sheep would decrease from left to right also. Figure 4.18 illustrates there is no correlation between structural density and skeletal representation for sheep/goat bones.

It was considered that perhaps the modification of the structural density readings to accommodate the element fragments under consideration might have influenced the result. The scan sites (Lyman 1994) were seen to correspond, often, to the zones (Dobney and Rielly 1988) that had been used to record the fragmentation data from the bone assemblage.

Thus, it was possible to correlate Lyman's figures with Dobney and Rielly's zones and work out the abundance of each zone in the various assemblages.

The figures for sheep/goat in Phase 2 are shown in Figure 4.19 where, on the top graph, the x-axis displays the various zones in decreasing order of structural density (left to right). No pattern is evident. The lower graph plots structural density against the number of zones retrieved. It can be seen that the data is essentially a cloud with no discernible trend and a regression line with a very slight slope, suggesting a very slight positive correlation between structural density and survival of bone. Figure 4.20 shows very similar results for sheep/goat from Phase 3.

Any link between bone structural density and survival would be likely to be consistent over time. In case the results in Figures 4.19 and 4.20 may have been influenced by small sample size the same exercise was carried out for all sheep/goat bones retrieved from all occupation phases on site. Figure 4.21 illustrates that there is a slightly stronger positive correlation in this case, so it can perhaps be tentatively suggested that there may be a link between structural density and bone survival in the sheep/goat bones.

4.3.5 Utility indices as factors affecting survival

In order to examine whether bone utility might explain the element distribution pattern Binford's (1978) normed utility indices were plotted against %MAU for the skeletal zones quantified for the element distribution analysis. The results for sheep/goat are plotted in Figures 4.22 and 4.23.

Figure 4.22 shows the normed General Utility Indices (%GUI) for sheep/goat bones retrieved from Phases 3 and 4. No strong correlation was found. Similarly in Figure 4.23 there is no correlation between %MAU retrieved and the modified utility indices (%MGUI). Figure 4.24 shows the %MAUs for the skeletal zones arranged in order of decreasing %GUI.

As far as the current writer is aware no one, has yet published utility indices for cattle or red deer. Recognising that it is unwise to "apply a model of economic utility based on caribou and sheep to species of very different anatomical confirmation" (Rowley-Conwy et al. 2002, 77) this exercise was not carried out for these species.

At Bostadh there is no evidence to suggest the element representation is strongly affected by structural density or bone utility. In the case of structural density this may be illusory as the sample sizes are very small.

4.3.6 The antler material

The antlers were treated differently in the analysis because they fulfil a different role, both in the life of the animal and for the people on the site, from the other animal bones. Antler is different from other bones in that it is solid all the way through and that it grows from the tip, in the manner of a plant (Davis 1987, 59) rather than from several centres of ossification as do the cartilage bones (Davis 1987, 47 – 53). Antlers also differ from other bones in that they are external on the body of the animal and non-permanent, being re-grown every year. Arguably, their visibility on the live animal is of prime importance, their size and stature being a signal to other animals, exacting a varying health and nutrition cost to the bearer. Prime stags must invest large amounts of energy into growing antlers, even before they use them in fighting off rivals. The antler could, therefore, be regarded as fulfilling a different role for the deer than all its other bones. Deer sometimes consume antlers after shedding, in order to gain the mineral wealth within them. As a store of nutrition antler can be seen as being valuable to the deer, though it cannot be argued that the deer perceives that consciously, of course.

The other reason to treat antler differently in the analysis is that they are of value to people as raw material for manufacturing tools and decorative items. Antler combs were among the finds at Bostadh. The antlers would probably have been treated differently from the other bone valued for its durability and workability (they soften if soaked in water) and it is possible that considerable effort went into collecting it from the surrounding land before it could be consumed by other animals.

Because antler is cast every year it cannot be included in element representation analysis as the number of antlers contributed by an individual is not known. Being a useful resource, possibly more so than other bone, the deposition of antler is unlikely to mirror that of other bone. The use of antler during prehistory, through industrial production, and the subsequent dispersal of products and waste material (perthotaxic processes), will remove antler from the assemblage excavated from the site. Prehistoric use of antler also affects sullegic, post-excavation, taphonomic processes. A proportion of the antler material retrieved from site, and the artefacts fashioned from antler, will tend to be sent to people who specialise in the study of worked bones and artefacts, rather than to the person examining the other (unmodified) bone. Consequently, it can be argued that the taphonomy of antler is different from that of other bone, so it is necessary to treat the two differently and to expect the antler on the assemblage on the analyst's bench to represent a tiny proportion of that originally on the site. Worked antler and antler artefacts were retrieved from Bostadh and antler with obvious modification was removed along with worked antler objects such as combs and sent to the worked bone specialist for examination (Tim Neighbour, pers. comm.).

Eleven fragments of antler were retrieved from ten different contexts on the site. Six fragments displayed chop marks. The fragments were six tine points, four antler bases, and only one reasonably long section of beam. The material probably represents fragments rejected as unsuitable for working.

The fragments that showed signs of modification only displayed cut marks, always near the end of the fragment where the antler had eventually been cut through. Most displayed several cut or chop marks on both sides of the fragment, attesting to the strength that makes antler so useful as manufacturing material. No signs of smoothing or filing the bone could be seen, nor any indication of attempts to cut the fragments along the plane of the beam. Therefore it can be concluded that this material has been rejected as unsuited for working.

The assemblage is too small to indicate anything of seasonality but three antler fragments were from shed antlers and one was still attached to the skull. The shed antler could have been picked up at any time of the year, but as argued here, their value, to deer and humans alike, probably resulted in antlers being collected soon after they were cast.

4.3.7 Element representation in other animals

4.3.7.1 Pig

Pigs were represented by only eleven identifiable specimens. Three of these were mandibular molar fragments; four were maxillary teeth; two were radius fragments; and fragments from one femur and one humerus were also present.

4.3.7.2 Otter

Otter elements retrieved from the site included the mandible, femur, humerus, tibia, calcaneum and ulna. Ulna and scapula were under-represented, with only one of each retrieved, both complete elements. One fused and one unfused calcaneum were retrieved but none of the other small leg or feet bones were retrieved and identified as otter. The mandible was the most abundant otter element represented, with nine complete and three incomplete fragments present. All identifiable mandibles had the tooth row present, an important factor in their identification as otter, rather than as any other similarly sized carnivore, such as cat for example. Five fragments of femur; five of tibia; and three fragments of pelvis were also retrieved.

The element distribution by phase for otter was as follows. In Phases 1 only two complete mandibles and one complete humerus were retrieved. In Phase 2 four mandibles were retrieved, two of them complete and two almost complete. Two complete femurs, a metapodial and a calcaneum were retrieved; two almost complete pelvises; a complete, unfused tibia diaphysis and two other tibia fragments were also retrieved from this phase.

Two elements from otter, a complete humerus and a complete metapodial, were retrieved from Phase 3.

Phase 4 had the greatest number of otter bones and also the greatest number of elements represented. Four mandibles, one femur, two humerii, one metapodial, one pelvis, one ulna and one scapula were the complete bones retrieved from Phase 4. Complete, unfused otter bones in the assemblage were two femurs, one femur distal diaphysis, a calcaneum and a tibia distal epiphysis. The remaining otter specimens were a fragment of unfused distal epiphysis from a femur and a mandible with the permanent premolar erupting.

4.3.7.3 Horse

Only sixty identifiable specimens came from horse. For all four phases there were eighteen bones from the head and neck, twenty five from the lower leg and foot, and thirteen from the upper legs and only four from the pelvis and scapula girdles. Phases 1 and 3 had five bones each from horse and fourteen horse bones were retrieved from Phase 4. The remaining thirty six bones were retrieved from Phase 2. A range of elements was present in each phase with no bias towards any body part observed.

4.4 Age at death

4.4.1 Age at death of sheep/goat

4.4.1.1 The epiphyseal fusion evidence

The epiphyseal fusion data for age at death of sheep/goat are listed in Tables 4.9 to 4.16. The figures are provided for each phase for the bones identified as sheep/goat (Tables 4.9 to 4.12), then, since no roe deer bone was identified in the assemblage, the assumption is made that the bones identified to "small ruminant" are also sheep/goat so they are added to the sheep/goat figures (Tables 4.13 to 4.16).

Table 4.9: The epiphyseal fusion evidence for sheep/goat, Phase 1 (n = 60)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	19	1	95	6 months
Phalanges	11	2	85	12 months
Tb d, Mc d, Mt d, Cal.	9	12	43	18 – 24 mo
Fe d, Tb p, Hu p.	3	3	50	36 – 42 mo

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc – metacarpal
mn – mandible
mt – metatarsus
pe – pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

The results in Table 4.9 show the epiphyseal fusion data for sheep/goat in Phase 1. They are odd in that the proportion of animals appearing to survive to 36 months seems to be greater than the proportion of animals surviving to 18 – 24 months. While this is most likely a consequence of the small numbers involved it also serves to remind us that the figures are not samples from one population of animals.

Table 4.10: The epiphyseal fusion evidence for sheep/goat, Phase 2 (n = 86)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	22	2	92	6 months
Phalanges	20	2	91	12 months
Tb d, Mc d, Mt d, Cal.	8	17	32	18 – 24 mo
Fe d, Tb p, Hu p.	10	3	76	36 – 42 mo

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

The results for Phase 2 are shown in Table 4.10 and are similar to the Phase 1 data, indicating an apparently large number of deaths taking place when the animals were 18 – 24 months old. Again, the percentage of fused bones in the later fusing group (the distal femur, the proximal tibia and the proximal radius) is higher than might be expected. There are several reasons why this may be the case. It may represent the fact that a high proportion (76%) of the sheep/goat survived to over three years old. It could be that this figure is artificially high due to the preferential preservation and identification of fused elements over unfused elements. All three skeletal parts in this late-fusing group have "spongy" bone at the diaphysis ends near the fusion centre concerned. Fusion of an epiphysis to a shaft considerably strengthens the end of the bone. It may be that for animals killed at 36 – 48 months the later fusing skeletal parts, being unfused, are so fragile that they are easily destroyed as a result of taphonomic processes and are thus overwhelmed numerically by the stronger fused bones. This would give the impression that the majority of bones were fused, implying a greater proportional survival to this age than was actually the case.

The small numbers of bone ends in the sample again suggest that the epiphyseal fusion ages may be reflecting later taphonomic processes, perthotaxic through to sullegic processes, rather than the biotic and thanatic processes that would reveal something of the animal husbandry of the site.

Table 4.11: The epiphyseal fusion evidence for sheep/goat, Phase 3 (n = 81)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	26	4	87	6 months
Phalanges	6	5	55	12 months
Tb d, Mc d, Mt d, Cal.	10	22	31	18 – 24 mo
Fe d, Tb p, Hu p.	3	5	38	36 – 42 mo

Key

ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

The results from Phase 3 are shown in Table 4.11 and show fewer individuals surviving to over three years of age. There is a big increase in deaths in the second six months of life, more so than was observed in Phases 1 and 2. This might represent difficulties in keeping animals alive over the winter, but due to the small numbers of animals involved it might also just represent a few instances of feasting on young lamb.

Table 4.12: The epiphyseal fusion evidence for sheep/goat, Phase 4 (n = 59)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	23	1	96	6 months
Phalanges	5	0	100	12 months
Tb d, Mc d, Mt d, Cal.	12	9	52	18 – 24 mo
Fe d, Tb p, Hu p.	5	4	56	36 – 42 mo

Key

ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

The results for sheep/goat in Phases 3 and 4, given in Tables 4.11 and 4.12 respectively, once more appear to reflect the small numbers of epiphyseal ends present in the assemblages under consideration.

While Tables 4.9 to 4.12 may seem to suggest that a high proportion of sheep/goat survived to a reasonable age the small numbers of epiphyseal ends involved and the effects of the later taphonomic processes suggest these results are not meaningful.

One sullegic factor that might influence the above results is the fact that unfused bones remain more difficult to attribute confidently to species than do the fused bones. Hence, the younger, unfused bones may have been identified as "small ruminant" rather than more confidently as sheep or sheep/goat. As no roe deer bones were retrieved, it is safe enough, certainly for heuristic purposes, to assume all "small ruminants" were sheep/goat (probably sheep as almost no goat bones were retrieved). Thus the small ruminant category was added to the figures above and the calculations repeated.

Table 4.13: The epiphyseal fusion evidence for sheep/goat and small ruminants, Phase 1 (n = 76)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	20	4	83	6 months
Phalanges	11	2	85	12 months
Tb d, Mc d, Mt d, Cal.	10	16	38	18 – 24 mo
Fe d, Tb p, Hu p.	4	9	31	36 – 42 mo

Key

	mc - metacarpal	**sc - scapula**
ast - astragalus	**mn - mandible**	**tb - tibia**
cal - calcaneum	**mt - metatarsus**	**ul – ulna**
fe - femur	**pe - pelvis**	**p – proximal**
hu - humerus	**ra - radius**	**d - distal**

When Table 4.13 is compared with Table 4.9 above it can be seen that the inclusion of the specimens identified as "small ruminants" does increase the amount of unfused epiphyses that can be included in the calculation. Consequently, the apparently high proportion of animals surviving to over three years is diminished somewhat. The hypothesis that the figures are the result of a small data set, rather than any reflection of husbandry practices is supported.

Table 4.14: The epiphyseal fusion evidence for sheep/goat and small ruminants, Phase 2 (n = 116)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	23	3	88	6 months
Phalanges	27	14	66	12 months
Tb d, Mc d, Mt d, Cal.	9	23	28	18 – 24 mo
Fe d, Tb p, Hu p.	11	6	65	36 – 42 mo

Key

ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

As with the data for Phase 1 the inclusion of the small ruminant figures appears to increase the proportions of unfused elements counted. Comparing Table 4.14 with Table 4.10 shows that the relative proportions of animals still alive at each age stage (% fused) decreases when the bones identifiable only to "small ruminant" are counted, suggesting the apparently high survival rate is an artefact of the small sample size. The small sample size is, in turn, affected by caution in attributing unfused bones to species.

Table 4.15: The epiphyseal fusion evidence for sheep/goat and small ruminants, Phase 3 (n = 104)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	26	4	87	6 months
Phalanges	7	7	50	12 months
Tb d, Mc d, Mt d, Cal.	11	40	22	18 – 24 mo
Fe d, Tb p, Hu p.	3	6	33	36 – 42 mo

Key

ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

Similar results are found for the sheep/goat bones from Phase 3. When Table 4.11 and Table 4.15 are compared it can be seen that the figures for the percentage alive drops slightly as a result of including the small ruminant bones, a high proportion of which were unfused.

Table 4.16: The epiphyseal fusion evidence for sheep/goat and small ruminants, Phase 4 (n = 63)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	23	2	92	6 months
Phalanges	5	0	100	12 months
Tb d, Mc d, Mt d, Cal.	15	9	65	18 – 24 mo
Fe d, Tb p, Hu p.	5	4	55	36 – 42 mo

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

Comparing Table 4.12 and 4.16, the fusion data for sheep/goat with the data for sheep/goat plus small ruminants, for Phase 4, shows a different result from the previous phases. The percentage alive at 18 – 24 months appears higher for the sheep/goat and small ruminants than for the sheep/goat only. This probably reflects the small sample size again, as only four extra epiphyseal ends had been recorded as "small ruminant", three of which were fused.

Tables 4.14 to 4.16 lend further support to the hypothesis that the data are too few to provide convincing ageing evidence for sheep/goat from epiphyseal fusion alone. The small number of phalanges retrieved from deposits derived from Phase 4 illustrates this particularly well, all five retrieved were fused. It would obviously be foolish to extrapolate a hundred percentage survival rate to one year old on these data.

Neonatal deaths are listed on Table 4.17. The figures refer to NISP and generally come from metapodials with unfused proximal epiphyses, but also from elements that have the lighter, more porous texture (and smaller size) typical of neonatal bone.

Table 4.17: Post-cranial neonatal bones – sheep/goat and small ruminants

Phase	Total NISP (post-cranial)	No of neonatal elements (NISP)	% neonatal elements
1	128	8	6.0
2	169	10	6.0
3	186	1	0.5
4	99	3	3.0

Table 4.17 illustrates the number and percentage of neonatal post-cranial bones of sheep/goat and small ruminants in the assemblages from the four phases. While the figures might reflect a general improvement in the ability to maintain neonatal stock to a greater age they are small numbers of bones representing small numbers of animals so it is perhaps unwise to read too much into them. The fragile nature of neonatal bone also decreases its chances of surviving, so these figures are likely to be underestimates.

Ageing evidence derived from mandibles may be expected to escape some of these taphonomic problems, not least because all evidence is obtained from the same skeletal part. In addition, teeth are more durable than bone, particularly than unfused, young bones.

4.4.1.2 The dental evidence for age at death of sheep/goat

In general, few mandibles with tooth rows intact were retrieved so the mandibles from each phase will be described briefly here and their age assessed following Moran and O'Connor (1994). As Moran and O'Connor found attrition state to be a less reliable indicator of age than the state of eruption of the tooth, the eruption data are prioritised here over attrition data in the assessment of age. When only attrition data are present there is often a wide age range possible for the mandible. As noted by Moran and O'Connor (1994, 262) it is difficult to assess age on mandibles derived from animals over 36 months with any degree of accuracy, which has implications for the interpretation of seasonal slaughter patterns in older animals. Therefore only loose estimates of age have been made when based on attrition data alone, and it should be noted that for categories such as "> 24 months" the animal could be several years older than 24 months of age.

Table 4.18: dental ageing evidence for sheep/goat – Phase 1

Context	dp4	P4	M1	M2	M3	Age
199	14L					< 24 months
653	16L		6A	e		< 12 months
425		2C				18 - 24 months
635		4A	9A	7A		18 – 24 months
355		12S	9A			> 48 months

Wear stages from Payne (1973, 1987). Estimated ages at death based on Moran and O'Connor (1994).

Only five mandibles with dental data were retrieved from Phase 1 and the wear data is displayed in Table 4.18. Two mandibles still bearing dp4 were present, one of which had no other teeth surviving in the mandible, and dp4 at wear stage 14L so can only be regarded as probably being less than 2 years old. The other mandible with dp4 also had M1 at wear stage 6A and M2 erupting through the bone, suggesting the animal might have been between 6 and 12 months old at time of death. Three mandibles had P4 present; one had it at wear stage 2C indicating it might have derived from an animal between 24 and 30 months, according to Moran and O'Connor's suggested eruption age of 24 months for P4, and their observation that it achieves 8A and 9A fairly rapidly. Another mandible had P4 in early wear (4A) but had M1 at 9A and M2 at 7A, all of which might suggest an age at death of around 18 – 24 months of age. The fifth mandible listed on Table 4.18 had M1 at the persistent (and uninformative) wear stage 9A and P4 well worn at 12S suggesting a more mature animal, aged over four years. No mandibles from this phase had M3 present.

It can be seen from Table 4.19 that a wide range of ages at death are present in Phase 2, ranging from very young (4 – 6 months) to fully mature, extending to an age whereby assessment of age is difficult (> 48 months). There is evidence for slaughtering, or unintentional death, of animals in their first autumn (animals less than six months at death) and there is evidence for winter kills (deaths at six to twelve months). Two mandibles derive from animals killed between 24 and 30 months old, indicating summer slaughter, and the presence of older animals, over 48 months, indicates the ability to maintain stock over the winter and thus retain a breeding population.

Table 4.19: dental ageing evidence for sheep/goat – Phase 2

Context	dp4	P4	M1	M2	M3	Age
164	16L		3C			4 - 6 months
226	14L		6A	v		4 - 6 months
250	16L		5A	v		4 - 6 months
363	14L		3B			4 - 6 months
364	16L		5A	v		4 - 6 months
439	16L		6A	v		4 - 6 months
328	16L		8A			6 – 12 months
364	16L		6A			6 – 12 months
414	14L		7A			6 – 12 months
276			8A	5B		6 – 18 months
148	22L		9A	6A	not v	12 - 17 months
188					v	< 17 months
512	14L					< 24 months
40		2C	9A	8A		24 – 30 months
188				9A	2A	24 - 36 months
188		7A	9A	8A	2A	24 - 36 months
717		4A	9A			24 - 30 months
884		9A	14A	9A		> 24 months
173		9A	9A			> 30 months
221					16G	> 48 months
288		12S	12A	9A		> 48 months

Wear stages from Payne (1973, 1987). Estimated ages at death based on Moran and O'Connor (1994).

It is not proposed to construct kill-off curves (*sensu* Payne 1973) for this data. The data are too few to attempt a meaningful reconstruction of economic patterns, particularly given that the archaeological occupation phase from which these mandibles were excavated may have lasted several decades, emphasising the taphonomic loss that has affected the material. Such taphonomic losses affect bone material preferentially, in particular, younger bone tends to be more fragile and more easily destroyed and hence the kill-off curve is unlikely to be accurate. The data can be compared to the fusion results however for Phase 2 by grouping the dental data into age groups that resemble those used in the fusion analysis and noting the proportion of dead individuals in each age group. Of course, issues of interdependency affect this exercise, as the data in the fusion tables do not necessarily refer to individual animals. The comparison was carried out by calculating the cumulative percentage of dead animals at each fusion wear stage for the fusion and dental data. For example, by the age of 12 months only 4 out of a total of 84 epiphyses were unfused, indicating animals dead by that age. Conversely, the dental data show 9 out of the 21 mandibles was from animals that were dead by one year old.

Table 4.20: comparison of age data from dental and fusion evidence for Phase 2

Age	% dead (fusion)	% dead (teeth)
6 months	2	28
12 months	5	43
18 – 24 months	24	62
36 - 42 months	28	81

The lack of correlation, shown in Table 4.20, is not surprising given the problems inherent in both ageing methods. Lack of correlation between fusion and mandibular age at death data probably reflects the poor survival of younger unfused bones. The dental data are likely to present the more accurate picture, particularly as they derive from one fairly resistant element. Table 4.21 displays the tooth wear and eruption data for sheep/goat mandibles retrieved from contexts in Phase 3.

Table 4.21: dental ageing evidence for sheep/goat – Phase 3

Context	dp4	P4	M1	M2	M3	Age
98	16L					< 24 months
36	16L					< 24 months
285	14L		3C			6 – 12 months
112	16L		4C			6 – 12 months
112	16L					< 24 months
454	16L					< 24 months
112	16L					< 24 months
218		8A	9A	8A		> 30 months
37				5B		12 - 18 months

Wear stages from Payne (1973, 1987). Estimated ages at death based on Moran and O'Connor (1994).

The small sample, with only four mandibles displaying molar teeth, reveals little about ages at death in Phase 3. The animals appear at first to be generally younger than in the previous phase but this is a result of few molar teeth surviving in the mandibles.

Table 4.22: dental ageing evidence for sheep/goat – Phase 4

Context	dp4	P4	M1	M2	M3	Age
88	14L		4C	v		< 6 months
142	14L		8B			6 – 12 months
142	14L					< 24 months
378	14L					< 24 months
205	16L		5A	v		< 6 months
378	18L		9A	5A	v	18 months
138	20L		9A			> 12 months
88	23L					< 24 months
53		15A	12A	9A		> 48 months
149		4A	9A	5A		24 – 36 months
149		5A	9A			> 24 months
56		7A	9A	7A	2A	24 – 36 months

Wear stages from Payne (1973, 1987). Estimated ages at death based on Moran and O'Connor (1994).

The animals in this study, reared on machair land, might be expected to have ingested a considerable amount of sand while grazing, which presumably would hasten the attrition of the teeth. An initial glance at the tables above appears to confirm this assumption, certainly in the case of dp4, where the teeth are mainly in the later wear stages. Four mandibles from Phase 2 are at the persistent wear stage 16L at the age of 4 – 6 months (aged on eruption of M2, see Table 4.19). Moran and O'Connor (1994, 277) found the 28 individuals in their sample aged 4 to 7 months at death had dp4 at wear stages between 13L and 17L, so the Bostadh material fits within that range. However, an individual in Phase 2 had dp4 worn to stage 22L at 12 – 17 months, supporting Moran and O'Connor's conclusion that the variability of the wear states of the fourth deciduous premolar was a poor indicator of age beyond the first six months of life. Some of the mandible sample used by Moran and O'Connor may have derived from sheep living on machair, particularly as there were Soay and Shetland sheep in the sample (Moran and O'Connor 1994, 276). It is not known whether the Soay and Shetland sheep in the sample used by Moran and O'Connor derived from machair grazing sheep. It is worth considering the possibility that the sheep in the sample from Bostadh may have been younger than they appear from the tooth attrition data. Unfortunately, too few tooth eruption data exist in the samples to verify or disprove this hypothesis.

4.4.2 Age at death of cattle

4.4.2.1 Epiphyseal fusion evidence

Table 4.23: epiphyseal fusion evidence for cattle - Phase 1 (n = 42)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Sc p, pe	5	0	100	7 – 10 months
Hu d, Ra p, pph, mph	14	2	88	12 – 19 months
Tb d, Mc d,	3	3	50	24 – 30 months
Mt d	0	1	0	30 – 36 months
Cal	1	0	100	36 – 42 months
Fe d, Fe p, Tb p, Hu p, Ra d, Ul p,	7	6	54	42 – 48 months

Key

ast - astragalus	**mc – metacarpal**	**sc - scapula**
cal - calcaneum	**mn – mandible**	**tb - tibia**
fe - femur	**mt – metatarsus**	**ul – ulna**
hu - humerus	**pe – pelvis**	**p – proximal**
	ra – radius	**d - distal**

Fusion ages from Silver 1969.

Table 4.23 shows the fusion evidence for the cattle bones from contexts in Phase 1. It can be seen that the small size of the sample is influencing the results, particularly in the 24 – 30 month age class and the 30 – 36 month age class. For that reason it is proposed to add the age classes together to get early, middle and late fusing specimens (e.g. Chaplin 1971, 129; Reitz and Wing 1999, 183). This masks any information on seasonal killings that may be present in the data by making each age class cover a longer period (12 months or more). It is worth noting that the above table suggests very few deaths of young cattle, in the first two years of life. This is also true in Phases 2, 3 and 4, as shown in Tables 4.24 to 4.26 below.

Table 4.24: epiphyseal fusion evidence for cattle – Phase 2 (n = 64)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Sc p, pe	7	0	100	7 – 10 months
Hu d, Ra p, pph, mph	28	3	90	12 – 19 months
Tb d, Mc d,	3	3	50	24 – 30 months
Mt d	1	1	50	30 – 36 months
Cal	2	2	50	36 – 42 months
Fe d, Fe p, Tb p, Hu p, Ra d, Ul p.	8	6	57	42 – 48 months

Key

ast - astragalus	**mc – metacarpal**	**sc - scapula**
cal - calcaneum	**mn – mandible**	**tb - tibia**
fe - femur	**mt – metatarsus**	**ul – ulna**
hu - humerus	**pe – pelvis**	**p – proximal**
	ra – radius	**d - distal**

Fusion ages from Silver 1969.

It can be seen in Table 4.24 that the survival rates are high in Phase 2 with 57% of epiphyses appearing to survive until four years of age. The high survival rate of young animals, where

100% appear to be surviving to 7 – 10 months is probably a factor of the small sample size and the under-representation of scapula and pelvis in the assemblage from Phase 2.

Table 4.25: epiphyseal fusion evidence for cattle – Phase 3 (n = 151)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Sc p, pe	1	0	100	7 – 10 months
Hu d, Ra p, pph, mph	79	9	90	12 – 19 months
Tb d, Mc d,	11	7	61	24 – 30 months
Mt d	9	8	53	30 – 36 months
Cal	1	2	33	36 – 42 months
Fe d, Fe p, Tb p, Hu p, Ra d, Ul p.	6	18	25	42 – 48 months

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc – metacarpal
mn – mandible
mt – metatarsus
pe – pelvis
ra – radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal
Fusion ages from Silver 1969.

Table 4.25 shows the epiphyseal fusion evidence for cattle bones retrieved from Phase 3 and it appears that fewer animals are surviving to the 42 – 48 month age group. Similar results were found for the sheep/goat data from Phase 3, which might reflect difficulty during the transition phase between Late Iron Age and Norse cultures. The sample size for Phase 3 cattle bones is also bigger than for any of the other phases, which might explain the different results also.

Table 4.26: epiphyseal fusion evidence for cattle – Phase 4 (N = 74)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Sc p, pe	7	0	100	7 – 10 months
Hu d, Ra p, pph, mph	25	4	87	12 – 19 months
Tb d, Mc d,	11	5	69	24 – 30 months
Mt d	2	4	33	30 – 36 months
Cal.	1	1	50	36 – 42 months
Fe d, Fe p, Tb p, Hu p. Ra d, Ul p,	11	3	79	42 – 48 months

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

Table 4.26 illustrates the epiphyseal fusion results for the cattle bones retrieved from contexts in Phase 4. The small numbers of bones are probably influencing the results strongly here with an apparent survival rate of 79% to the oldest age category. The percentage survival is calculated from only fourteen bone fragments however, and the eleven fused epiphyses could, conceivably, all have derived from two animals. In order to counteract this the cattle fusion data are displayed as early-, middle- and late-fusing specimens in Tables 4.27 to 4.30.

Table 4.27: Cattle epiphyseal fusion, separated into early, middle and late fusing elements – Phase 1 (n = 42)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	19	2	90	7 – 19 months
Middle-fusing specimens	3	4	43	24 – 36 months
Late-fusing specimens	8	6	57	> 36 months

Table 4.27 presents the data from Phase 1. The fact that the fusion age groups are sampling different populations and not demonstrating a continuum of age at death, suited for displaying on a survival type chart is clearly demonstrated, the small sample size is influencing the percentage of fused epiphyses.

Table 4.28: Cattle epiphyseal fusion, separated into early, middle and late fusing elements – Phase 2 (n = 64)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	35	3	92	7 – 19 months
Middle-fusing specimens	4	4	50	24 – 36 months
Late-fusing specimens	10	8	56	> 36 months

The figures in Tables 4.27 and 4.28 indicate that there is no clear kill-off pattern emerging from these data, but, generally, cattle are surviving into maturity in reasonably high proportions and there is no early kill-off of young animals evident in the data.

Table 4.29: Cattle epiphyseal fusion, separated into early, middle and late fusing elements – Phase 3 (n = 151)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	80	9	90	7 – 19 months
Middle-fusing specimens	20	15	57	24 – 36 months
Late-fusing specimens	7	20	26	> 36 months

The epiphyseal fusion from Phase 3 appears to show a decrease in the number of surviving animals over time such as might be expected from this exercise. This is probably due to the larger sample size (NISP = 151), but may indicate more cattle dying at a younger age in Phase 3 than in other phases. Comparisons are not feasible however due to the small sample sizes for the other phases.

Table 4.30: Cattle epiphyseal fusion, separated into early, middle and late fusing elements – Phase 4 (n = 74)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	32	4	89	7 – 19 months
Middle-fusing specimens	13	9	59	24 – 36 months
Late-fusing specimens	12	4	75	> 36 months

Similar problems exist with the figures from Phase 4 as those from Phases 1 and 2, with no clear pattern being evident, but with a fairly high percentage survival to over three years of age, and little sign of high kill-off in the first year.

Neonatal deaths are not recorded on these tables and are listed separately in Table 4.31.

Table 4.31: Post-cranial neonatal bones – cattle

Phase	Total NISP	No of neonatal elements (NISP)	% neonatal elements
1	75	5	7
2	153	6	4
3	218	1	0.5
4	118	1	0.8

As with the sheep/goat/small ruminant data these data may suggest a general improvement in livestock management over the four occupation phases, but caution should be exercised in their interpretation as the numbers of elements are so small that they may reflect only one or two individuals in each phase.

4.4.2.2 Dental evidence of ageing in cattle

Only fifteen cattle mandibles with teeth displaying any ageing evidence were retrieved from the site so only the most general picture can be obtained of the ages of cattle at death.

Table 4.32: dental ageing evidence for cattle – Phase 1

Context	dp4	P4	M1	M2	M3	Age
628	a					A (0 – 1 month)
653	a		v			A (0 – 1 month)

Wear stages from Grant (1982), age estimates from Halstead (1985).

Table 4.33: dental ageing evidence for cattle – Phase 2

Context	dp4	P4	M1	M2	M3	Age
435	a		v			A (0 – 1 months)
638	c		a			B (1 – 8 months)
622	a		v			A (0 – 1 months)
329	d		a			B (1 – 8 months)

Wear stages from Grant (1982), age estimates from Halstead (1985).

Table 4.34: dental ageing evidence for cattle – Phase 3

Context	dp4	P4	M1	M2	M3	Age
112			h	f	Erupting	D (18 – 30 months)
112		a	g	g	b	E (30 – 36 months)
107		c	d			C (8 – 18 months)

Wear stages from Grant (1982), age estimates from Halstead (1985).

Table 4.35: dental ageing evidence for cattle – Phase 4

Context	dp4	P4	M1	M2	M3	Age
54	d					B (1 – 8 months)
53	h		f			C (8 – 18 months)
53	j		d			C (8 – 18 months)
149			m	j		> D (> 18 - 30 months)
365	f		a			B (1 – 8 months)
60					g	G (adult)

Wear stages from Grant (1982), age estimates from Halstead (1985).

The mandibular ageing data indicate some neonatal and young deaths, which were not evident from the epiphyseal fusion data. The comparative lack of mandibles from more mature cattle may be a result of the larger bones being destroyed before burial, either through scavenging by dogs or destruction by other means. Teeth may be missing from older animals due to being loosely fixed in the jaw. As herbivorous animals age their teeth move upwards and forwards slightly in the mandible to compensate for the attrition of the occlusal surface. Hence, as the animal ages the roots of the teeth increasingly appear above the line of the bone on the mandible, which might be expected to make them less secure in the jaw; after death with the loss of the surrounding muscle. Conversely, the more fragile state of younger bone may be expected to affect the preservation of mandibles from young animals as argued for the epiphyseal fusion evidence above.

The observation can be made that some animals are dying, or being killed, shortly after birth. The numbers are insufficient to draw any secure conclusions on economic management of the cattle herd, or, indeed, to reflect poor husbandry practice and the inability to maintain young animals alive. Similarly cattle are surviving to an age at which they could be producing milk, or being used for traction. The age at death data do not rule out the milking of cattle, as both neonates and calves near the end of their first year of life are present in the assemblage. Hence, regardless of whether McCormick's (1992) theory, that high death rates of calves after weaning indicates a milking economy, is accepted or rejected, milking of cattle could be taking place.

4.4.3 Age at death of red deer

4.4.3.1 Epiphyseal fusion evidence

A slightly different approach has been taken to the red deer fusion evidence. The fusion stages for red deer epiphyses available to the current writer (Egorov 1967) were given as ranging over one or two years. For example the fusion age for the calcaneum was given as being 3 – 4 years, that for the proximal femur as 4 –5 years of age. Hence any evidence of seasonality will not be obtainable from this data and for this reason the fusion data have been assessed in three groups, early-, middle- and late-fusing, only. Little seasonality evidence has emerged for the other taxa, due to small sample sizes requiring the amalgamation of fusion age groups, so the use of Egorov fusion ages for red deer is justifiable. The early fusing epiphyses are the pelvis acetabulum, the scapula articulation and the proximal ends of the proximal and middle phalanges. The middle-fusing epiphyses are the calcaneum, distal metapodials, the proximal radius, the distal tibia and the distal humerus. The late-fusing epiphyses are the proximal ulna, the distal radius, the proximal tibia and humerus and the proximal and distal femur.

Table 4.35: Red deer epiphyseal fusion, separated into early, middle and late fusing elements – Phase 1 (n = 15)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	2	2	50	By 2 years
Middle-fusing specimens	5	1	83	2 – 4 years
Late-fusing specimens	4	1	80	4 – 6 years

Table 4.36: Red deer epiphyseal fusion, separated into early, middle and late fusing elements – Phase 2 (n = 39)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	4	1	80	By 2 years
Middle-fusing specimens	16	0	100	2 – 4 years
Late-fusing specimens	12	6	66	4 – 6 years

Tables 4.35 and 4.36 illustrate the epiphyseal fusion data from red deer bones in Phases 1 and 2 respectively. The small sample size makes it hard to draw any secure conclusions, but

there is evidence for the presence of mature red deer, so it would appear that prime animals could be caught during these phases.

Table 4.37: Red deer epiphyseal fusion, separated into early, middle and late fusing elements – Phase 3 (n = 65)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	17	7	71	By 2 years
Middle-fusing specimens	25	7	78	2 – 4 years
Late-fusing specimens	5	4	56	4 – 6 years

Table 4.38: Red deer epiphyseal fusion, separated into early, middle and late fusing elements – Phase 4 (n = 78)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	24	3	89	By 2 years
Middle-fusing specimens	20	7	74	2 – 4 years
Late-fusing specimens	21	3	88	4 – 6 years

Two things are immediately obvious from Tables 4.37 and 4.38. The small numbers of epiphyses in the samples again preclude the use of the data for constructing kill-off curves, emphasising as they do the lack of relationship between the different groups of epiphyses. Secondly, the ages of fusion are much later than is the case for cattle and sheep. To an extent these ages of fusion are immaterial, as has been discussed previously, but the high survivorship is apparent from the tables, particularly in the largest data set, from Phase 4. The ages of fusion (Egorov 1967) may be later because the animals tested were not domesticated and so may have been living at a lower nutrition plane. Alternatively, the test for fusion of the epiphysis to the diaphysis may be stricter than those employed by Silver (1969).

4.4.2.2 The dental ageing evidence for age at death for red deer

Only 11 mandibles with dental ageing evidence were retrieved from Bostadh. The mandibular age scoring system devised by Brown and Chapman (1990, 1991a) was tested on a sample of red deer mandibles of known age (see 3.2.6.4). Difficulties were encountered with using the system however, so the method was rejected in favour of visual comparison of attrition state of the eleven mandibles with a series of red deer mandibles of known age, and the results are displayed on Table 4.39.

Table 4.39: dental ageing evidence for red deer – all phases

Phase	Context	Age
1	379	5 yrs
2	209	Neonatal
3	35	2 – 3 yrs
3	98	4 – 5 yrs
3	285	7 – 9 yrs
3	98	5 yrs
3	101	> 8 – 10 yrs
3	102	> 9 yrs
4	365	> 12 yrs
4	66	5 – 6 yrs
4	56	4 yrs

A range of ages of red deer are present in the sample of mandibles. One neonatal individual may represent a foetus in a hind, or might be a sign of animal management or the proximity of the herd to the settlement. Neonates in an assemblage are sometimes interpreted as evidence of domestication, but in this case, one neonatal individual could have been obtained anywhere, for any purpose. There are also older animals on site, including one older than twelve years of age. The fact the molars may be heavily worn due to the machair soil in the area should also be considered. However, it seems clear that a range of ages of animals is being taken, which neither contradicts nor supports any hypotheses about management or hunting of the herd. Domestication can be ruled out, as presumably there would be little advantage in maintaining deer to a great age such as over nine years, if they were consuming valuable resources that could otherwise be put to other use. Therefore it can be assumed that the animals are being hunted, and it might be that the older ones succumb more easily to the chase.

4.5 Taphonomic indicators

4.5.1 State of preservation of the specimens

Each specimen was assessed for its general state of preservation. An "a" indicates a fresh, shiny surface with a clean, almost new appearance. A "b" indicates a duller surface, still in good condition with little or no sign of abrasion, or exposure of the inner bone structure. A specimen assessed as "c" has some signs of abrasion and part of the surface missing, as does a specimen in category "d", the difference being whether less than 50% of the bone surface is absent ("c") or more than 50% is missing ("d"). Table 4.40 illustrates the preservation state of all identifiable bone fragments from all taxonomic groups. The table allows the state of preservation between all phases to be compared in order to see whether the condition of the bone alters according to the length of time it is spent buried in the ground.

Table 4.40: the state of preservation of the identified specimens

Phase	a	b	c	d	total
1	14 (4%)	303 (87%)	27 (8%)	3 (1%)	347
2	26 (4%)	508 (83%)	71 (12%)	5 (1%)	610
3	8 (1%)	605 (81%)	130 (17%)	8 (1%)	751
4	8 (1%)	497 (83%)	86 (14%)	5 (1%)	596
None	1 (1%)	67 (72%)	21 (23%)	4 (4%)	93

It can be seen from Table 4.40 that the numbers in each preservation category are remarkably consistent over the four occupation phases with little indication that bone condition worsens over time. The contexts for which phasing was not available do seem to have less well preserved bones in them than in the phased contexts. This is probably because these contexts were redeposited or represent atypical conditions, such as surface deposits damaged by windblown sand. Such situations would make it difficult to allocate a phase to such a context and would affect the condition of the bones within it.

4.5.2 Staining of the bones

Table 4.41 lists the degree to which the identified and recorded specimens exhibited staining or marking on the surface of the bone. Most bones were not stained or marked by anything ("0"). A specimen which was less than 25% stained or discoloured was denoted by "1", 25% - 50% staining was a "2", 50% - 75% a "3" and greater than 75% a "4". General discoloration of a specimen, due to being in a slightly different chemical sediment matrix, was not counted as staining, which was mainly signs of burning or staining from metal objects.

Table 4.41: indications of staining or marking

Phase	0	1	2	3	4	total
1	336	0	2 (0.6%)	1 (0.3%)	8 (2.3%)	347
2	597	5 (0.8%)	3 (0.5%)	2 (0.3%)	3 (0.5%)	610
3	730	7 (0.9%)	0	2 (0.3%)	12 (1.6%)	751
4	596	2 (0.3%	0	0	1 (0.2%)	599
None	93	0	0	0	0	93

It can be seen from Table 4.41 that the majority of bones were not stained or marked in any way. Among the fragments retrieved from Phase 1, 3.2% were stained; 2.1% of fragments from Phase 2 were stained; 2.8% from Phase 3; and 0.5% from Phase 4. None of the fragments from contexts for which phasing was not available showed any sign of staining, suggesting these contexts may represent non-anthropogenic deposits such as wind-blown sand.

4.5.3 Gnawing marks on bones

Very few bones showed any indication of gnawing marks. In Phase 1 only four specimens had been gnawed by a carnivore. In Phase 2, nine specimens showed signs of having been gnawed, and in Phase 3, nine specimens, again, displayed evidence of carnivore attrition. In Phase 4, ten specimens had been chewed by a carnivore (dog/fox) while two displayed signs of rodent gnawing.

The low rate of gnawing indicators is not surprising as dogs will tend to destroy completely, or store away for later (thus removing from the other deposited faunal remains), any bones they have access to (personal observation; Payne and Munson 1985; Stallibrass 1990). Arguably a bone that shows marks from gnawing, without being destroyed completely, represents a bone that has survived the attentions of a carnivore. The animal may have been disturbed, or the bone may have been rejected in favour of a preferable one, which may have been less compact, or contained more marrow. The degree to which a carnivore will destroy a bone will be dependent on the relative size of the bone and the carnivore.

4.5.4 Butchered bones

Table 4.42: bones displaying butchery marks

Phase	Butchered bones	Total
1	40 (12%)	347
2	80 (13%)	610
3	91 (12%)	751
4	49 (8%)	599
None	7 (8%)	93

A very small percentage of the assemblages showed any signs of butchery marks. Arguably this is not surprising as butchery marks, particularly associated with primary butchery, or dismembering a carcass, tend to indicate poor butchery, where the knife has missed the target, i.e. failed to sever the joint it was intended to. Secondary butchery marks, from filleting, during or after cooking, would similarly be rare as the aim is to cleave meat from the bone, rather than to impact on the bone itself. Hence, although the figures for butchered bones may look relatively small they are in fact a strong indicator that the material represents domestic refuse.

4.6 Association of bones with specific contexts

In order to investigate the nature of bone deposits on site it is proposed to briefly describe *important* bone-bearing contexts in their archaeological setting and then look at the bones they contained. The difficulty lies in the word *important*, which is used, and emphasised, deliberately to instil awareness that this is a subjective exercise, unlikely to be replicable by another worker. The decision was made that any bones found in contexts deriving from under floor pits should be studied. Also, any caches of bone that were recognised during excavation should also be described. The term "special deposits" is used to infer that the deposits differ from ordinary household waste in some way. The degree to which they can be considered special may just reflect the fact they have survived intact in what might be considered an unusual environment. The chance that any such bones represent a deposit which was special or significant to the people depositing it cannot be denied, but is hard to prove from the archaeological record.

4.6.1 House 1 special deposits

Pits on the floor of House 1 were found with bones in them. Among the foundation deposits dating from Phase 2 was a pit (497) filled with context 496. The pit fill was described as containing "a large amount of bone" (Neighbour 2001, 13) of which six were identifiable. Two fragments of humerus from a large ruminant were present, along with one cattle metapodial fragment, two fragments of sheep/goat metatarsal and a fragment of radius identifiable only to medium-sized mammal. A cattle tooth (P4) was found in a posthole (fill 445) associated with a putative hearth. A stone lined pit contained a cattle scapula, an otter mandible and an unfused proximal epiphysis from a red deer proximal phalanx. All were almost complete.

Table 4.42b: the "special deposits" in House 1 – foundation deposits

House	Context	Type of feature	Phase	Element	Species
1	496	Pre-floor pit fill	2	Humerus x 2	Large ruminant
				metapodial	Cattle
				metatarsus	Sheep/goat
				radius	Medium mammal
1	445	Post hole associated with putative hearth	2	P4 tooth	Cattle
1	482	Stone lined pit	2	Scapula	Cattle
				Mandible	Otter
				Phalanx epiphysis	Red deer

Table 4.42c: bones contained in House 1 – sand layers

House	Context	Type of feature	Phase	Element	Species
1	466 (see Fig 2.15)	Wind blown sand	3	Molar tooth	Cattle
				Middle phalanx	
				Tibia fragment	
				Metacarpal fragment	
				Middle phalanx	Red deer
				Tibia fragments	Sheep/goat
				Humerus fragments	
				Metacarpal fragments	
				Femur fragments	
1	438 (see Fig 2.15)	Sand layer	3	Fragment of tibia	Red deer
				Fragment of radius	
1	288 (see Fig 2.13)	Sand layer	3	Fragments of mandible and teeth	Cattle
				Phalanges	
				Fragments of metapodials Fragment of tibia	
				Metatarsal	Red deer
				Metacarpal frags	Horse
				Phalanges	

Table 4.42c: bones contained in House 1 – sand layers (continued)

House	Context	Type of feature	Phase	Element	Species
1	285 (See Fig 2.14 and 2.15)	Sand layer	3	Proximal phalanx	Cattle
				Mandible fragment	Red deer
				Deciduous premolar	
				Fragment of ulna	
				Fragments, mandibles and teeth.	Sheep/goat
				Fragments, metapodials	
				Fragments of femur and pelvis	
				Complete mandible	otter
1	284 (Figs 2.10 and 2.11)	Sand layer		Fragments of metapodials and phalanges	cattle
				Fragment of ulna	Cattle?
				Distal phalanx	Red deer
				Fragment of humerus	
				Maxillary molar	horse
				Mandible fragment	
				Fragment of femur	Pig
				Tibia fragment	Sheep/goat
				Humerus fragment	
				Ulna fragment	
				Tibia fragment	Small ruminant
				Proximal phalanx	Large ruminant
1	441	Floor of structure M	3	Complete calcaneum	Cattle
				Fragment of proximal metacarpal	
				Fragment of pelvis	Red deer
				Proximal phalanx	Large ruminant
				Unfused calcaneum and epiphysis	Sheep/goat
				2 metapodial fragments	

Phase 3 deposits in House 1 accumulated after abandonment and are mainly sand layers over the floor of the house.

Sand layer 466, in the interior of House 1, (see Figure 2.15) contained twenty six identifiable bone fragments. Of these identifiable to a single species four derived from cattle; a molar tooth, a middle phalanx and fragments of tibia and metacarpal. One red deer middle phalanx was also present and the sheep/goat bones were fragments of humerus, tibia, metacarpal and femur. Sand layer 438 (see fig 2.15) contained two fragments of identifiable bone both from red deer; one was a fragment of proximal tibia and the other a fragment of proximal radius. Layer 288 (see Figure 2.13) contained 33 identifiable bone fragments. Thirteen derived from cattle and included fragments of mandible and teeth, first and second phalanges, metapodials, and a fragment of distal tibia. This layer also contained a metatarsal from a red deer and four fragments of horse bone, all from the lower limb (metacarpals and phalanges). The sheep/goat bones were all mandibles and teeth and metapodials with only two exceptions. A fragment of pelvis (ischium) was present as well as a piece of atlas vertebra. The other bone of interest in this context was a tibia shaft (both ends missing) from an otter. Three bone fragments could only be identified to the level of "large ruminant" and they were fragments of mandible, calcaneum and metacarpal. It may be significant that the majority of these bones are low-meat yielding bones, which might be expected to constitute butchery waste. Five of the thirty three bone fragments displayed butchery marks (15%) which is slightly higher than for the site as a whole.

It is possible that the abandoned and possibly roofless House 1 was used as a butchery area. Alternatively, the bones may represent the remains left by dogs as they are predominantly the dense, compact parts of the skeleton that might be expected to survive carnivore gnawing. However, none of the bones shows any signs of carnivore gnawing on the bone surface. In addition, they are all in a fairly good state of preservation (2 and 3) suggesting most of the bone surface is intact, which might not be expected in bones subjected to extensive canine attentions.

Layer 285, another sand layer within House 1 at the abandonment stage contained nineteen bones, of which only one, a proximal phalanx, derived from cattle, while three, a mandible fragment and a deciduous premolar and a fragment of proximal ulna, were from red deer. The sheep/goat bones in this layer comprised mandibles, teeth and metapodials, two small fragments of femur and one fragment of pelvis. A complete otter mandible was also present. Of the bones not identifiable to a single species, four out of six were low-meat bearing bones, mainly metapodials and teeth. The remaining two were both radius fragments from large mammals. The bones appear to represent an episode of use of the abandoned building for food processing, probably butchering, but conceivably consumption of waste by dogs.

Context 284 contained eighteen fragments of identifiable bone. The cattle bones were all low-meat bearing bones from the lower leg, metapodials and phalanges. A fragment of ulna, classed as possible cattle, was also present. The red deer bones were a distal phalanx and a (distal) fragment of humerus. A maxillary molar tooth and fragment of mandible from horse were also present in this context, as well as a fragment of pig femur. The sheep/goat bones were high-meat-yielding, comprising fragments of tibia, humerus and ulna. A fragment of tibia identified as small ruminant, so sheep/goat as well, was also present. A proximal phalanx from a large ruminant was also retrieved.

The floor of Structure M (443) contained nine identifiable bone fragments. Bovine elements present were 4 phalanges and one deciduous premolar. A fragment of red deer metacarpal and a fragment of proximal radius identified as "large mammal" were also present, as well as a small fragment of unfused tibia from a sheep/goat.

The "spread midden" (441) infilling the house after abandonment contained eight identifiable specimens. The two bovine fragments were a complete calcaneum and a fragment of proximal metacarpal. A fragment of pelvis from red deer and a proximal phalanx from red deer or cattle were also present. Sheep/goat bones included an unfused calcaneum and epiphysis and two metapodial fragments.

4.6.2 House 2 foundation pits Phase 2

A pit under the floor of House 2 was filled by context 574, described as mottled orange and red peat ash. It contained one sheep/goat metacarpal diaphysis fragment; an unfused epiphysis from a cattle middle phalanx; and a small fragment of sheep/goat pelvis. The fragments, being small, could represent accidental inclusions, or the products of clearing a floor.

4.6.3 House 3 foundation pits, Phase 2

Table 4.42d: bones contained in House 3 – pre-floor pits

House	Context	Type of feature	Phase	Element	Species
3, structure L	229	Pit fill	2	phalanx	Cattle
	881 (Fig 2.5)	Pit and fill	2	metapodial	Cattle
	873 (Fig 2.5)	Pit and fill	2	Fragment of tibia	Red deer
				Fragment of femur	Sheep
	872 (Fig 2.5)	Pit and fill	2	P4	Sheep/goat
	885 (Fig 2.5)	Pit and fill	2	ulna	Otter
	884 (Fig 2.5)	Sub-circular Pit and fill	2	Phalanges x 2	Cattle
				Fragment of tibia	Large ungulate
				epistropheus	Sheep/goat
				Metacarpal fragments x 2	
				Metatarsal	
				Mandible	
				P4	
				M3	
				Pelvis fragment	
3, structure G	209	Pre-floor pits	2	Mandible	Red deer
				Humerus	
				Molar tooth	
				Astragalus	Cattle
				Scapula fragments	
				Middle phalanges x 2	Sheep
				Proximal phalanx	Sheep
				Humerus fragment	Sheep/goat
				Pelvis	

Structure L in House 3 also had pits underneath the floor (see Figure 2.5). They are believed to date to Phase 2. Pit 273 was filled with context 229, which contained a proximal cattle phalanx. Pit 882, although said to contain animal bones (Neighbour 2001, 29) did not have any identifiable fragments. Pit 881 contained a fragment of cattle metapodial which had two butchery marks on it. Pit 873 had a fragment of proximal tibia from red deer and a fragment of (fusing) distal femur from a sheep. Pit 872 contained a permanent fourth premolar from a sheep or goat. Pit 885 contained an ulna from an otter. It had no taphonomic indicators and was a fused bone indicating it was from an adult. The feature was described as a large sub-rectangular pit, 0.95 m x 0.7 m and 0.16 m deep (Neighbour 2001, 30). The upper fill of the pit was black peat ash that contained "limpet shells and animal bone fragments" (ibid. 30). It is possible that this feature was used after abandonment by an otter, which might have introduced the animal bone fragments and the limpet shells. Otter holts have been recognised from fish bone assemblages containing high proportions of fish species such as freshwater eels, butterfish and sea scorpions that are unusual in anthropogenic deposits. These species are favoured particularly by otters (Cerón-Carrasco and Parker Pearson 1999, 278) and such an assemblage was retrieved from deposits in the wall chamber of the broch at Dun Vulan (ibid. 278; Cerón-Carrasco 1993). However, only sixteen fish bones, mainly saithe vertebrae, were retrieved from this context (Ruby Cerón-Carrasco, pers. comm.) suggesting that the deposit was not accumulated by otters and, consequently, that the otter bone is possibly an accidental intrusion. The possibility that the deposits were laid down intentionally cannot be ruled out, and peat ash, limpets and bones from certain animals may have had some significance in the past and been buried to bring good luck or ward off evil. Alternatively, the deposit may represent the cleaning of an early, possibly temporary hearth, used when the building was being constructed.

A sub-circular pit, 884, contained 11 identifiable mammal bone fragments, including two complete, butchered, (fused) phalanges from cattle; a fragment of tibia shaft identified as large ungulate; and eight fragments of sheep/goat bone. Two of the sheep/goat bones were butchered and all were small fragments that might represent kitchen waste that had been cleared off a floor. The pit was lined with green clay (Neighbour 2001, 30) and filled with orange and black burnt peat, which might easily have been derived from a floor. Indeed all the bone fragments retrieved from the pits in Structure L could represent accidental accumulations from floor sweepings or food waste accidentally dropped into pits, as they are all either small elements or small fragments of bones. However, the lining of the pit with green clay and burnt peat may indicate that the material was deposited as part of a ritual act or it may have had a practical function such as for cooking.

Six pits were cut into the sand at the base of Structure G; context numbers 814, 207, 208, 209, 211 and 212 (see Fig 2.5). Sixteen bone fragments were retrieved, of which four could not be identified beyond the level of medium mammal or small ruminant. Fifteen of the bones derived from Pit 209 and one from Pit 211.

Five complete bones were present, all in Pit 209; a red deer mandible; a cattle astragalus; the remaining complete bones, two middle phalanges and one proximal phalanx were all from sheep. The proximal phalanx was butchered, but none of the other bones displayed any taphonomic features. One other butchered bone was present in 209; it was a (fused) proximal half of sheep/goat humerus. The remaining bones in pit 209 were all fragments; of cattle scapula; humerus and molar tooth from red deer; femur, pelvis and incisor tooth identified only as medium mammal; an unfused proximal fragment of femur; and a tiny piece of sheep/goat metapodial. A small fragment of sheep/goat pelvis was retrieved from pit 211 and was stained, with less than 25% of its surface being discoloured.

The presence of complete bones in Pit 209 might suggest the deliberate deposition of animal bone material. The sheep phalanges, small, compact bones, might have been incorporated in the pit deposits accidentally, and survived subsequent taphonomic processes by chance. The red deer mandible is from a neonate, the only mandible from a neonatal deer retrieved from the site. It may represent a symbolic deposit, deliberately placed in the pit in an act forming part of a belief system. Alternatively, it might be an accidental deposit and the fragile bone may only have survived because of its location in the pit. Bones deposited in midden deposits are likely to be crushed, trampled and redeposited; all processes that might result in the destruction of a fragile neonatal mandible to a condition in which it was not identifiable. Similarly, pits are more likely to be excavated than midden deposits, so a bone in a pit has a higher chance of appearing on the analyst's bench than does one deposited in a midden. It therefore seems improbable that the pits in Structure G in House 3 represent ritual deposits, although there may be further evidence in the form of the other environmental material and artefacts retrieved from the pits.

4.7 The bird remains

Bird bones were retrieved from all four phases and from seven contexts for which phasing was not available "? ph" in Table 4.43 below. The species retrieved were; guillemot (*Uria aalge* Pontopiddan 1763); puffin (*Fratercula artica* L.); cormorant (*Phalacrocorax carbo* L.); gannet (*Sula bassana* L.); herring gull (*Larus argentatus* Pontopiddan 1763); Brent goose (*Branta bernicula* L.); and Manx shearwater (*Puffinus puffinus* Brünnich 1764). No bones from domestic fowl were retrieved

Only one bone fragment was butchered, a tibio-tarsus from a Brent goose. One fragment of puffin humerus showed signs of blackening, possibly due to burning (O'Sullivan 1997). The only other taphonomic indicators noted were eroded bones, two were noted to be "slightly eroded" and two to be "eroded" (O'Sullivan 1997). One guillemot carpometacarpus had a healed break (*ibid.*).

Table 4.43: the hand-retrieved bird bones

	gllmt	puffin	crmt	brnt g	herr gull	mx shrwtr	gannet	s. auk	diver	total
ph 1	1	5		2	1	1		1	1	12
ph 2	2	2	2	1						7
ph 3	5	29	3				1	4		42
ph 4	3		1		2			2		8
? ph	1	11	19							31
	12	47	25	3	3	1	1	7	1	100

Key

ph – phase
? ph – phase not known
gllmt – guillemot
crmt – cormorant
brnt g – Brent goose
herr gull – herring gull
mx shrwtr – manx shearwater
s. auk – small auk

One hundred bone fragments were identified to element and species (or to family / Order such as small auk and diver). The quantities of bird bone retrieved are small and with the exception of the butchered bone from a Brent goose, and possibly the burnt puffin humerus, all might represent natural deaths of birds around the site.

Figure 4.25 shows the element representation for all bird species from Phases 1 to 4. The numbers involved are small and all body parts are represented, including the more fragile, thin walled bones of the leg (tibiotarsus). It can be seen from Figure 4.25 that wing bones dominate the assemblage. The coracoid, a bone in the chest, is also well represented. The wing bones and the coracoid are compact, short bones and it seem likely that they are over-represented relative to the other bones because they are relatively more sturdy. Alternatively the element representation may indicate carcass processing and the use of or trade in feathers on the site (O'Sullivan 1997, 1). It seems more likely, however, that the survival of the wing bones is a result of the taphonomic processes operating on the assemblage as the bones are more compact and sturdy than leg bones, so more likely to survive in an identifiable state than the longer leg bones which might be vulnerable to fracturing into non-identifiable fragments.

Only Phase 3 has a reasonable number of bird bones (Figure 4.25). The contexts containing the greatest numbers of bones; contexts 37, 101, 284, 285 and 1000 are all midden deposits or sand deposits from House 1, in Phase 3, so they represent post-abandonment accumulation within the house walls. It therefore seems possible that some of the bird remains represent natural deaths and intrusive bones. However, it does seem likely that birds and their eggs might have provided a useful dietary supplement, particularly in the spring and early summer when they are more easily caught due to being on and around the cliffs for nesting and rearing young.

4.8 Measurements of mammal bones retrieved from Bostadh

A few elements were measured following the methodology listed in von den Dreisch (1976). Only fused bones were measured. Measurements were only taken when the bone was largely complete, or at least complete along the axis being measured. Due to constraints of time not all elements were assessed for measuring from this site. The measurements are presented in Table 4.44 below.

Table 4.44 The measurements taken from the mammal bone assemblage at Bostadh (mm)

measurements of astragalus				measurements of middle phalanx			
CATTLE	Bd	GLl	GLm	CATTLE	Bp	GL	SD
mean	36.6	57.6	52.6	mean	25.2	35.8	19.4
min	31.7	52.9	48.2	min	22.1	33.3	17.1
max	42.5	61.4	56.3	max	28.5	38.4	22.2
N	19	17	17	N	42	42	42
std dev	2.3	2.37	2.28	std dev	1.49	1.21	1.31
RED DEER	Bd	GLl	GLm	RED DEER	Bp	GL	SD
mean	29	43.1	40.8	mean	17.8	40.2	16.2
min	25.3	39	37.9	min	17.2	39.1	14.4
max	37.9	47.3	44.1	max	18.1	41.8	19.3
N	15	15	15	N	3	3	3
std dev	3.08	2.2	1.74	std dev	0.49	1.44	2.72
SHEEP	Bd	GLl	GLm	SHEEP	Bp	GL	SD
mean	16.2	25.7	24.8	mean	10.2	17.6	7.8
min	14.9	24.6	23.5	min	9.2	15.8	6.8
max	17.6	26.8	26.3	max	11.6	19.5	8.9
N	7	8	8	N	14	14	14
std dev	0.99	0.87	1.03	std dev	0.84	0.94	0.80

Table 4.44 (cont'd) the measurements taken from the mammal bone assemblage at Bostadh (mm)

measurements of first phalanx			
CATTLE	Bp	GL	SD
mean	24.6	52	21.1
min	22.1	47.7	17.9
max	27.5	57	24.2
N	45	43	44
std dev	1.46	2.05	1.37
RED DEER	Bp	GL	SD
mean	18.1	49.7	14.5
min	17.7	48.1	12.7
max	18.6	53.5	18.2
N	9	9	10
std dev	0.3	1.63	1.56
SHEEP	Bp	GL	SD
mean	11	32.2	8.9
min	9.9	30	8.2
max	12	36	9.5
N	17	17	17
std dev	0.61	1.56	0.40
HORSE	Bp	GL	SD
mean	46	72	28.4
min	46	72	28.3
max	46	72	28.5
N	2	2	2
std dev	0	0	0.14

No attempt will be made to compare the measurements with modern cattle as there are such a large variety of breeds of very different sizes existing in Britain today. Most are the result of many years of intensive, selective breeding for large size, so it is meaningless to compare them to prehistoric cattle, which may have been bred for smaller beasts, whether deliberately or accidentally.

The range of measurements obtained for the astragalus of cattle can be compared to measurements obtained from bones from other sites in Atlantic Scotland. The measurements from other sites are listed in Mulville (1999, 255) and the sites they are taken from cover a wide range of structural types, geographical location and dates. These measurements show little variation despite the range of dates and locations from which the animal bones derive. For example the measurement GLl ranges from 51.3 at Sollas in North Uist to 61.0 at Howe in Orkney (average measurement obtained; Mulville 1999, 255). Measurements from

Bostadh range from 52.9 (minimum) to 61.4 (maximum). The cattle measurements all lie within the range of measurements obtained from excavated specimens at Howe (Smith et al 1994, Table 44mf). Thus the cattle are similar in size to those elsewhere in Atlantic Scotland during prehistory.

One red deer measurement for the astragalus (mean Bd) is identical to the measurement obtained from a modern red deer of four and a half years old (Smith et al 1994, Table 29mf). The other measurement (mean GLl) is 2.9 mm smaller than that obtained from the modern specimen. Similarly the measurements for the first phalanx fall within the range given by Smith et al. (ibid.). All the Bostadh figures given above fall within the range obtained from the Howe deer bones (ibid. Table 44mf). It can therefore be assumed that the red deer at Bostadh were similar in size to those at Howe and also to modern deer, implying they were small, relative to continental and North American animals

The sheep astragalus measurements are very similar (means are within 1 mm of each other) to those obtained from Dun Vulan in South Uist (Mulville 1999, 257) and Sollas in North Uist (ibid.). As with cattle, the range of measurements obtained from a selection of Western Isles sites (mean GLl from 24.1 to 25.4 mm) is close to the range measurements obtained from Bostadh.(GLl range from 24.6 to 26.8 – Table 4.44). The measurements from sheep all lie within the range of those obtained at Howe (Smith et al 1994, Table 44mf). It can be concluded that the sheep at Bostadh were not exceptional in size compared to others elsewhere in Atlantic Scotland.

4.9 The effect of sample processing on the retrieved assemblage

4.9.1 The effect of sample processing on the elements retrieved

A simple test was run to ascertain whether the sample processing had affected the elements retrieved. It is expected that smaller elements and the bones from smaller animals will be under-represented, relative to larger elements and larger animals, if sieving of some sort is not carried out (Payne 1975, 1972). In order to test whether this had indeed happened the following calculations were made. The percentage of fragments retrieved from large and small elements of cattle, red deer and sheep/goat were compared for the hand retrieved assemblage and the sample processed assemblage. The results are given in Table 4.45.

Table 4.45: the effect of sample processing on element size retrieved.

Retrieval	animal	Element category	% retrieved
Hand	Cattle	Large	59
Hand	Cattle	Small	41
Sampled	Cattle	Large	43
Sampled	Cattle	Small	57
Hand	Sheep/goat	Large	70
Hand	Sheep/goat	Small	30
Sampled	Sheep/goat	Large	46
Sampled	Sheep/goat	Small	54

Key to Table:

Large elements: scapula, humerus, radius, ulna, pelvis, femur, tibia

Small elements: teeth, phalanges, astragalus, calcaneum, vertebrae.

It can be seen that sample processing increased the relative proportion of smaller elements retrieved in both size categories of animal and that the difference appears to be more marked in sheep/goat as would be expected since the smaller elements will be proportionately much smaller in these animals and consequently more liable to be overlooked in the trench.

4.9.2 The effect of sample processing on the size of animals retrieved

A similar test was carried out to discover whether sample processing had affected the relative proportions of the various mammal species retrieved. The species present in the assemblage were divided into three size categories. Cattle, red deer, horse and seal were categorised as large, as were the elements that had not been assigned one size category but instead had been classified according to size, that is, "lgr" and "lgm", large ruminant and large mammal respectively. Sheep, goat, pig, small ruminant and medium mammal were classified as medium, and otter and dog as small.

Table 4.46: The effect of sample processing on the proportions of animals of different sizes retrieved at Bostadh.

Retrieval	Animal size	% retrieved
Hand retrieved	Large	72 (n = 1496)
Sample processed	Large	28
Hand retrieved	Medium	66 (n = 877)
Sample processed	Medium	34
Hand retrieved	Small	93 (n = 42)
Sample processed	Small	7

Table 4.47: The effect of retrieval method on animal size categories retrieved

	% of hand retrieved	% of sample processed
Large	64.0	58.0
Medium	34.0	41.0
Small	2.0	0.5

Table 4.46 shows that a greater relative proportion of medium-sized animals shows up in the sample processed material than is the case with the larger animals. The trend does not continue, as might be expected, with the small animals, probably reflecting small sample size (n = 42).

Likewise, Table 4.47 shows that, as expected, the sample processing seems to increase the proportion of medium-sized animals relative to large animals in the assemblages, but again the small number of identifiable bone specimens from small animals (otters and dogs) may be affecting the figures as one would expect the proportion of small animals to be higher in the assemblage retrieved through sample processing than in that retrieved by hand.

4.10 Conclusion

Chapter 4 presents the results from the assemblage from Bostadh and includes some methodological explanation when the methodology used has been developed in response to results already obtained. In general, the assemblages from the four occupation phases are small, which precludes much meaningful statistical analysis. To compensate in some way for this a descriptive approach has been taken where possible, and all but the most basic statistical techniques have been avoided for fear of lending authority where it is not due. However, it is now proposed to sum up the findings from the analysis of the mammal remains from Bostadh Beach acknowledging that the taphonomic concerns are understood and are probably no greater than those affecting other assemblages.

It appears that cattle, sheep/goat (probably sheep), pig and horse were present on the site. Red deer were a resource around the site that was extensively used. There is evidence, albeit scant, of dogs. Pigs of breeding age were on site from Phase 2 onwards, presumably providing a regular supply of pig meat that is not evident in the assemblage. This might be because the young pig bones do not survive in an identifiable condition, or because the carcasses were so extensively used that little in the way of identifiable bone was dumped. Horse and dog remains would not necessarily be expected to be found with domestic waste and there may be evidence that horse remains formed part of some "special deposits" associated with pits under the floor of the houses. Otter and seal are also represented in the assemblage but are not felt to be of economic significance until possibly some use of otter pelts in the Norse period. Other carnivorous remains were a pine marten mandible which denotes trading connections outside the island.

The body part representation evidence indicates that cattle, sheep and red deer were brought onto site as whole animals, rather than butchered quarters of meat. Possible exceptions are cattle in the Late Iron Age / Norse transition phase (Phase 3) and red deer in the Norse period (Phase 4). In both instances there is a preponderance of hindquarters. Low meat yielding cattle bones dominate the assemblage from Phase 3, which again might indicate something different happening with cattle in that period. Butchering, in order to export meat from the site, would be one explanation, and the mammal bone evidence from post-abandonment House 1 hints at its use as a butchery area. A second possible explanation for the apparent relative abundance of low meat-yielding elements would be that the area used for butchery and waste disposal was fully excavated and sampled because it happened to be located within an abandoned structure. This might result in more of the material being retrieved, relative to the high meat-yielding elements, than had deposition occurred in a midden or similar context where material might have spread over a greater area and been less likely to be retrieved.

Increased use of red deer in the Norse phase is accompanied by a proportional increase in high meat yielding bones and greater proportions of hind limbs in the assemblage which may indicate procurement of the animals from further away, or trading with outsiders in prime deer meat. Deer seem to be treated differently from the other animals on the site, which might reflect different procurement strategies.

The hypothesis that the assemblage was mainly a result of taphonomic biases was tested by examining the element representation data for sheep/goat in terms of the relative structural density of the skeletal zones. No correlation was found. Because no correlation was found with the sheep/goat remains and because of the small sample size, cattle bones were not examined in terms of structural density. No published structural density figures for red deer could be found so the deer remains were not tested either. The sheep/goat remains were tested against Binford's economic utility index models and no correlation was found. As bison and caribou were believed to be poor comparanda for cattle and red deer in utility models the other main taxa were not tested.

The age at death data revealed a range of ages of all three main taxa and relatively few neonatal deaths, particularly in cattle. The red deer may be managed rather than more randomly hunted, as fewer older and young individuals are present in the assemblage than might be expected from a hunting or farming strategy, although the ageing evidence is scant. No conclusions on seasonal variation on site occupation, by humans or animals, could be drawn from the ageing data from Bostadh. Hence, no speculation on transhumance as a means of separating animals from crops was made. The three most commonly represented animals on site are similar in size to their equivalents elsewhere in prehistoric Atlantic Scotland.

There is evidence for the exploitation of other food resources including birds and marine animals such as fish and shellfish (Cerón-Carrasco 2002; Cerón-Carrasco forth.). The results presented here will be further discussed in Chapter 6 where they will be contrasted with other sites in the locality and elsewhere in Atlantic Scotland.

Chapter 5 The analysis of the data from Loch na Beirgh

5.0 Introduction

The following chapter details the results of the analysis of the mammal bone from Beirgh and has a similar layout to the preceding chapter.

5.1 The species retrieved and their relative abundance

5.1.1 The species retrieved

The site at Beirgh yielded bones from the following species: cattle (*Bos taurus* L.), red deer (*Cervus elaphus* L.), horse (*Equus cabullus* L.), sheep (*Ovis aries* L.), goat (*Capra hircus* L.), pig (*Sus scrofa* L.), otter (*Lutra lutra* L.), common seal (*Phoca vitulina* L.) and grey seal (*Halichoerus grypus* Fabricius 1791). Henceforth these animals will be referred to by their British common names.

Table 5.1a: the species present in the Beirgh assemblage

Species	Abundance
Cattle	***
Red deer	***
Sheep	***
Pig	**
Grey seal	*
Common seal	*
Horse	*
Otter	*
Goat	*

Key
Number of fragments retrieved (NISP)
***	- scarce (1 – 9)**
****	- common (10 – 99)**
*****	- abundant (100 – 1000)**

Table 5.1b: The NISP for the assemblage retrieved from Beirgh

Species	NISP
Cattle	906
Red deer	609
Sheep /goat	320
Pig	43
Grey seal	8
Common seal	6
Horse	5
Otter	4

Tables 5.1a and b illustrate the relative abundance of species retrieved from the assemblage from the Phase 5 occupation levels at Loch na Beirgh. There is no reason to suspect the pig is wild boar, it is more likely to represent a domesticated animal. Very few bird bones were retrieved, probably due to only one of the contexts dating from this phase having been sieved. Forty-six bones were identified as bird, of which 14 were identified to family or species. They included cormorant, gannet and "small auk, c.f. guillemot". Two bones identified only as "small bird" were also present. Any of the bones might represent intrusions on the site, and are unlikely to illuminate anything of the culture or environment of the site during the Final Cellular phase of occupation.

5.1.2 Quantification

It can be seen from Figure 5.1 that cattle dominate the assemblage from Beirgh whether quantified by weight or by NISP. Red deer are also relatively abundant at approximately one third of the retrieved assemblage regardless of the quantification method used. Sheep and domestic pig, the smaller species retrieved, are less abundant. None of the contexts within the phase examined for this thesis was sample processed or sieved (screened) for smaller bones, which probably explains this relative dearth of the smaller taxa. Grey seal is present in the weight graphs, but not the NISP chart, reflecting the comparative heaviness of their bones. The lack of bird bones may reflect the lack of sieving, or it might reflect the relative fragility of bird bones compared to those of mammals. As at Bostadh the bird bones may be intrusive, representing birds using the site for nesting or roosting. Two bones described as "small bird" may have been prey species of a raptor using the abandoned site as a roost or a place in which to consume its prey.

The adjustment of the primary data to account for the elements not identified to one taxon makes very little difference to the relative proportions of species present; probably due to the fairly large assemblage size and the relatively small number of sheep and sheep/goat bones retrieved.

The absolute figures for NISP and weight are presented in order of abundance in Figures 5.2 and 5.3. They demonstrate the predominance of the larger taxa, cattle and red deer. The differences in NISP figures are so great in the Beirgh assemblage (ranging from 1 to 906) that it is useful to plot the NISP figures on a logarithmic scale. Grey seal, common seal, horse, otter and goat are present in very small quantities, which may represent accidental intrusions. The one goat bone retrieved was a deciduous premolar, one of the relatively few bones from which it is possible to differentiate sheep and goat. Because of the difficulties involved in distinguishing goats from sheep, the goats may be under-represented in this assemblage.

Table 5.2: the minimum numbers of individuals (MNI) in the assemblage from Beirgh

Species	MNI	Element(s) calculated on
red deer	34	L sc
cattle	20	L ast, R cal
sheep/goat	9	R mc, R sc
pigs	4	L cal
grey seal	2	R mn, L ra. L ul
otter	2	L ul
roe deer	1	L mc
horse	1	R ra, R tb
common seal	1	L sc, L + R ra, L + R fe

Key

ast - astragalus	**mt - metatarsal**
cal - calcaneum	**pe - pelvis**
fe - femur	**ra - radius**
hu - humerus	**sc - scapula**
mc - metacarpal	**tb - tibia**
mn - mandible	**ul - ulna**

The MNI figures show that the figure for red deer is particularly large, and that cattle are the next most abundant and sheep/goat under-represented. The MNI figures differ from the NISP data in that the red deer appear to be much more abundant when the MNI calculation is used. This might reflect the many inadequacies of the MNI concept, or it may indicate that the element on which the MNI was calculated, the scapula, was present in unusually large quantities compared to the other elements. The body part and element distribution analysis (5.2 and 5.3) will address this.

Figure 5.4 illustrates the relative proportions of species in terms of homologous elements (Bond and O'Connor 1999, 338). The method reduces the interdependence between the three taxa by expressing sheep/goat and red deer as "cattle equivalents". In Figure 5.4b variation along the x-axis shows variation in red deer numbers, while variation along the y-axis shows variation in sheep numbers. Variation in cattle numbers is shown as variation along a line from the origin to the top-right of the graph. The under-representation of sheep at Beirgh is immediately clear from this graph and from the pie charts displayed on Figure 5.4. The steady increase over time in red deer relative to sheep at Bostadh is demonstrated on Figure 5.4 also. The homologous element method is useful in that it counteracts the tendency for larger animals, with larger bones, which can fragment into more identifiable fragments, to be over-represented in a fragment count (NISP). Comparing Figure 5.4a with Figure 5.1g illustrates this point.

5.2 Body part representation

5.2.1 Were animals brought onto site as carcasses or jointed body parts?

A simple count of the number of fragments retrieved, from four elements from the hind and fore limbs, was carried out on the material from Beirgh. Only sheep/goat, cattle and red deer, the three most abundant taxa, were counted.

Table 5.3: limb representation (NISP)

	cattle	red deer	sheep/goat
Fore limb (sc, hu, ra, mc)	207	212	77
Hind limb (pe, fe, tb, mt)	232	196	82

Key

sc – scapula	**pe – pelvis**
hu – humerus	**fe – femur**
ra – radius	**tb – tibia**
mc – metacarpal	**mt - metatarsal**

The numbers are similar for hind and fore limb representation in the retrieved assemblage, suggesting that whole carcasses may have been brought onto site. As the assemblage from Beirgh is much larger than any of the Bostadh assemblages a similar exercise was carried out using the minimum number of elements (MNE) present. The MNE was taken as being equal to the maximum number of zones (>50%) present (Dobney and Rielly 1988), with side and size not being taken into account. Use of the MNE figure will reduce the effects of fragmentation of the specimens as well as reducing the chance of one element being counted more than once.

Table 5.4: limb representation (MNE)

	cattle	red deer	sheep/goat
Forelimb (sc, hu, ra, mc)	88	136	46
Hind limb (pe, fe, tb, mt)	65	62	36

Key

sc – scapula	**pe – pelvis**
hu – humerus	**fe – femur**
ra – radius	**tb – tibia**
mc – metacarpal	**mt - metatarsal**

Table 5.4 indicates that forelimbs predominate in all three species, particularly in red deer, where the bones from the forelimb are more than twice as common as the hind limbs in the retrieved assemblage. In cattle and sheep/goats, the difference in the quantities of hind and forelimb elements is less dramatic. Table 5.5 illustrates the minimum numbers of these eight elements present in the red deer assemblage from Beirgh.

Table 5.5: The MNE figures for red deer elements of the hind and fore limbs

Element	MNE	element	MNE
sc	56	pe	12
hu	45	fe	17
ra	28	tb	27
mc	7	mt	6
total	136	total	62

Key

sc – scapula	**pe – pelvis**
hu – humerus	**fe – femur**
ra – radius	**tb – tibia**
mc – metacarpal	**mt - metatarsal**

It can be seen that the discrepancy is caused by the much greater number of scapulae and humerii than of pelves and femora present in the assemblage, which may be caused by the scapula and humerus being more readily identifiable, or more resistant to destruction, than the pelvis and femur. Since the quantities of the lower limb bones from the hind and fore limb are broadly similar, there seems no reason to argue against the introduction of complete deer carcasses to the site. The additional scapula and humerii may perhaps indicate supplementation of the red deer supply by joints of venison.

5.2.2 Was the site at Beirgh a producer or a consumer site?

In order to explore whether there is any evidence of Beirgh having been a producer or consumer site a similar count was carried out comparing the quantities of high and low meat-yielding bones in the assemblage from Beirgh.

Table 5.6: Meat yield figures (MNE)

	red deer	*cattle*	*sheep/goat*
High meat yielding Pe, sc, hu, fe, tb, ra,	185	110	62
Low meat yielding Mn, cal, ast, pph/4, mph/4, dph/4	95	132	43

Key

pe - pelvis	**mn - mandible**
sc - scapula	**cal - calcaneum**
hu - humerus	**ast - astragalus**
fe - femur	**pph - proximal phalanx**
tb - tibia	**mph – middle phalanx**
ra - radius	**dph - distal phalanx**

The high meat yielding bones are predominant in red deer and sheep/goat and the lower meat yielding bones are slightly more abundant in cattle. The relative lack of low meat yielding bones in red deer is striking and might indicate that the deer were being butchered elsewhere and the poorer bones left behind. Such a situation may have come about as a result of the deer being butchered where they were killed, assuming the animals were hunted, and, by implication, killed, some distance from the site, and only the more valuable pieces were carried back. Alternatively, the deer meat may have been supplied from another site.

5.3 Element distribution

5.3.1 Quantification of elements

As with the bones from the assemblages from Bostadh the elements were quantified differently for further analysis with each end of the long bones being counted separately (see 4.3.1 and 3.2.9).

5.3.2 Element representation for cattle, sheep/goat and red deer

Figure 5.5 illustrates the element representation figures for cattle, sheep/goat and red deer. The graph for cattle indicates that the astragalus and calcaneum are most abundant, more than twice as abundant as would be expected if the elements were equally represented. The dominance of these small elements over larger ones is unusual in a site such as this where sieving has not been carried out. The abundance of small elements in the assemblage testifies to the diligence of the excavators, possibly a reflection of the fact the excavation was a student training exercise. It may also reflect the fact that the astragalus and calcaneum are distinctively shaped and easily recognisable (in the field and the laboratory) even if fragmented. They are also resistant to destruction, being of high structural density (Lyman

1994, 246), as are the next two most abundant elements, the proximal metacarpal and the scapula articulation. The least well-represented bones are the atlas, epistropheus (axis) and the distal metapodial. All three are distinctively shaped bones and the two vertebrae have generally high structural density values across most scan sites (Lyman 1994, 246). However, all three might fracture to a condition in which they were less identifiable to element and species, which might explain their relative scarcity. Of the lower meat producing bones (the head and feet bones, illustrated in pale blue and yellow respectively) only the mandible is present in an amount greater than expected. This might be due to it being more easily recognised, both in the trench and on the analyst's bench. Figure 5.6 provides another method of looking at the element distribution, arranging the various skeletal parts along the x-axis in the order they appear in the body, bones of the head to the left and the feet on the right. No pattern is obvious in the graph for cattle.

The sheep/goat element graph (Figure 5.5) indicates that there is a dearth of phalanges as expected where routine sieving has not been carried out. The astragalus and distal humerus are the most abundant elements and both have relatively high structural density values (Lyman 1994, 246; Ioannidou 2003, 358). The mandible is well-represented, as are the distal tibia, the proximal and distal metacarpals and the scapula articulation. Apart from the mandible the lower meat bearing bones of the head and feet are poorly represented, as is the ulna and the (less dense and late-fusing) proximal tibia and humerus. The problem of equifinality is obvious with these data as the rarer elements may be under-represented for several reasons, including relatively lower structural density and later fusion age.

For sheep/goat, Figure 5.6 shows no pattern. The astragalus is over represented, as is the case with cattle and red deer, and in general the more structurally dense elements appear to be well-represented.

In the case of red deer Figure 5.5 shows there is a greater range of values of O/E than in the other two taxa (values given in Appendix 5.1), and the standard deviation obtained (1.08) is higher than the mean value for O/E (1.0). There is a huge variation in the amounts of the different skeletal parts represented, with fifty-six scapulae present but only one mandible and one proximal metacarpal. The lack of mandibles seems very odd, with four fragments being present and an MNI of one. Some loose teeth were retrieved, four dp4s, nine M3s, thirteen teeth that could only be identified as mandibular molars, seven P3s and four P4s. The possibility of identification error is very remote as deer teeth and mandibles are quite distinctive from those of cattle, and indeed sheep. Mandibles from the other taxa are well represented with almost twice as many sheep/goat mandibles present as would be expected if all elements were distributed equally (Appendix 5.1, Table 2). The bones of the feet of red deer are under-represented as are the first two vertebrae and the metapodials, suggesting that joints of prepared meat may have been brought onto site, the heads and lower legs discarded elsewhere. Figure 5.6 illustrates the element distribution figures displayed in the order the elements are in the body and demonstrates the lack of bones from the feet, head and lower legs in the assemblage, thus supporting the hypothesis that jointed segments were brought onto site, perhaps to supplement complete carcasses. The relative lack of antler in the assemblage, compared to Bostadh certainly, backs up the hypothesis. Figure 5.6 shows the greater abundance of the high meat-bearing bones, particularly the structurally dense ones such as the distal humerus and scapula. Structural density may be affecting the bone survival of red deer elements in the assemblage at Beirgh, which will be explored below (5.3.4).

5.3.3 Element representation – comparison between taxa

Figure 5.6 suggests that there might be a similarity in the element distribution in cattle and sheep/goat at Beirgh and Figure 5.7 plots the various combinations of the three main taxa against each other in order to facilitate comparison. It appears that there is more similarity between cattle and sheep/goat than between any other pairing of the taxa. The difference between red deer and cattle are particularly striking, suggesting that the element distribution may not be caused solely by physical taphonomic forces alone, as it might be expected that such processes would affect the survival of bones from similarly sized species similarly.

The graphs lend support to the hypothesis that red deer are being treated differently.

5.3.4 The effect of bone structural density on element representation

In the interests of consistency with the Bostadh data, the effect of structural density on the differential survival of elements was tested. This was despite the comparative graphs suggesting that physical taphonomic forces were not a strong influencing factor on bone survival. Ioannidou's (2003) figures for bulk density of cattle and sheep/goat bones were also used on the Beirgh data; they had not been available when the Bostadh analysis was carried out.

Figure 5.8 illustrates the resulting graphs and the data clouds on the three graphs together with the low gradient of the regression line indicate a low correlation between structural density and bone survival at Beirgh. It is possible that, as suggested above, the taxa have been treated differently, in which case the survival of the various skeletal parts will be affected by some cultural process. Figure 5.9 shows the skeletal zones arranged in order of decreasing structural and bulk density and reveals no strong correlation between bone density and representation on site of the various skeletal zones.

Utility indices allow a measure of the relative usefulness of the different skeletal parts. Figure 5.10 demonstrates that there is no correlation between utility indices and sheep/goat element representation. This may reflect the relatively small assemblage of sheep/goat bones retrieved from Beirgh, which in itself is likely to be a reflection of the retrieval methods used, and the lack of a sieving programme at the time these contexts were excavated.

5.4 Age at death

5.4.1 Age at death of sheep/goat

5.4.1.1 The epiphyseal fusion evidence

The numbers of fused and unfused epiphyses (NISP) were summed by use of a query in Microsoft Access and the results tabulated in Table 5.7 below. The percentage of fused bones was calculated since fused bones indicate animals still alive at the end of a particular fusion period.

Table 5.7: The epiphyseal fusion evidence for sheep/goat, (n = 139)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	41	6	87	6 months
Phalanges	19	6	76	12 months
Tb d, Mc d, Mt d, Cal.	23	21	52	18 – 24 mo
Fe d, Tb p, Hu p.	8	17	32	36 – 42 mo

Key

ast - astragalus	**mc - metacarpal**	**sc - scapula**
cal - calcaneum	**mn - mandible**	**tb - tibia**
fe - femur	**mt - metatarsus**	**ul – ulna**
hu - humerus	**pe - pelvis**	**p – proximal**
	ra - radius	**d - distal**

Table 5.7 shows the epiphyseal fusion data for sheep/goat. The fusion evidence indicates that a decreasing percentage of animals survive (% fused) to increasingly older ages, as might be expected. There appears to be a reasonably high survival rate after the first year of life, which may be caused by the lack of survival of younger, unfused bones. It is likely that the dental data will provide a more accurate impression of the numbers of juvenile and

neonatal deaths. The very small number of specimens identified as goat allows the assumption that the vast majority of the bones identified as sheep/goat are in fact sheep. As no roe deer bones were retrieved, it can be argued that the bones identified as "small ruminants" can also be regarded as being sheep. Thus, the epiphyseal calculation can be repeated on a larger sample.

Table 5.8: The epiphyseal fusion evidence for sheep/goat and small ruminants, (n = 166)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early fusing epiphyses: Sc p, Hu d, Ra p, pe	43	9	83	6 months
Phalanges	19	6	76	12 months
Tb d, Mc d, Mt d, Cal.	26	34	43	18 – 24 mo
Fe d, Tb p, Hu p.	8	21	28	36 – 42 mo

Key
ast - astragalus
cal - calcaneum
fe - femur
hu - humerus
mc - metacarpal
mn - mandible
mt - metatarsus
pe - pelvis
ra - radius
sc - scapula
tb - tibia
ul – ulna
p – proximal
d - distal

Table 5.8 illustrates the epiphyseal fusion evidence for sheep/goat and small ruminants. The figures are very similar to those given in Table 5.7 for sheep/goat alone, reflecting the relatively small number of specimens identified only to the level of "small ruminant". It can be seen that the figures are affected by the problem of identifying unfused bones to species, as the numbers of unfused bones increase when the "small ruminant" specimens are added, resulting in the lowering of the "% fused" figures. The calculations above exclude specimens identified as neonatal during the analysis. Such bones would include metapodials in which the two diaphyses had not fused fully along their length, which happens in ungulates before birth (Silver 1969). Specimens identified as neonatal would also include very porous, small bones with bone ends unfused. Very few neonatal sheep/goat bones were retrieved at Beirgh, probably due to the recovery methods used. Table 5.8 shows a relatively high rate of deaths in the first six months (17%) a small proportion of deaths in the winter of the first year, then heavy losses in the second year of life. Survival to 3 – 3 ½ years is 28% indicating there was probably enough mature animals to maintain a viable breeding population. Neonatal deaths were low, possibly a factor of the retrieval methods used, together with high perthotaxic, taphic and anataxic taphonomic loss.

Table 5.9: Post-cranial neonatal bones – sheep/goat and small ruminants

Total NISP	No of neonatal elements (NISP)	% neonatal elements
379	3	0.8

5.4.1.2 The dental evidence for age at death of sheep/goat

The dental evidence for age at death of sheep/goat was assessed following Moran and O'Connor (1994) and Payne (1973). Eruption age was prioritised over attrition state as recommended by Moran and O'Connor. Only fourteen mandibles with teeth were present in the assemblage, so the amount of interpretation available from the data is rather limited.

Table 5.10: dental ageing evidence for sheep/goat

Context	dp4	P4	M1	M2	M3	Age (M)	Age (P)
291						Neonatal	Neonatal
356						Neonatal	Neonatal
358	13L		E			2 – 4 mo	2 – 6 mo
358	13L		1B	UE		c. 4 mo	6 – 12 mo
358	16L		2A	UE		c. 4 mo	6 – 12 mo
358	17L					> 6 mo	> 2 – 6 mo
358	13L		6A			6 – 12 mo	6 – 12 mo
362			9A	E		6 – 12 mo	6 – 12 mo
412	16L					6 – 24 mo	
358		4A	9A	7A	6A	24 – 36 mo	12 – 24 mo
378		7A	9A	5A	5A	24 – 36 mo	2 – 3 yrs
358		9A	brk			30 – 48 mo	
363					9G	> 24 mo	3 – 4 yrs
358			12A	9A	11G	> 36 mo	4 – 6 yrs

Key

Dp4 – fourth deciduous premolar **M1 – first molar** **UE - unerupted**
P4 – fourth permanent premolar **M2 – second molar**
Age (P) – Age according to Payne (1973) **M3 – third molar**
Age (M) – Age according to Moran and O'Connor (1994)

Table 5.10 indicates that a sizeable proportion of the mandibles derive from younger animals. The relative proportions of animals still alive at the end of the different age stages according to the two different methods of age assessment were then calculated. The results are presented in Table 5.11 and it is clear that the teeth data reveal a higher proportion of younger animals than do the post-cranial fusion data.

Table 5.11: comparison of age data from dental and fusion evidence

Age	% dead (fusion)	% dead (teeth)
6 months	5	36
12 months	9	50
18 – 24 months	29	57
36 - 42 months	42	71

5.4.2 Age at death of cattle

5.4.2.1 Epiphyseal fusion evidence

The methodology follows that used for sheep/goat (5.4.1.1). Cattle fusion ages can be divided up into six groups rather than the four groups available for sheep/goat, giving a greater number of age groups at which information about age at death can be obtained. The use of reasonably precise age at death categories, such as 12 – 19 months and 30 – 36 months, is useful. The former category would indicate deaths in the summer and the latter deaths in the winter, assuming calving occurred in the spring. In order to get a more general picture of herd survival it is helpful to amalgamate some of the age categories into three groups, early-, middle- and late-fusing elements. This has been done in Table 5.13.

Table 5.12: epiphyseal fusion evidence for cattle (n = 495)

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Sc p, pe	44	22	67	7 – 10 months
Hu d, Ra p, pph, mph	136	62	69	12 – 19 months
Tb d, Mc d,	29	27	52	24 – 30 months
Mt d	16	21	43	30 – 36 months
Cal.	9	24	27	36 – 42 months
Fe d, Fe p, Tb p, Hu p. Ra d, Ul p,	41	64	39	42 – 48 months

Key		
ast - astragalus	**mc - metacarpal**	**sc - scapula**
cal - calcaneum	**mn - mandible**	**tb - tibia**
fe - femur	**mt - metatarsus**	**ul – ulna**
	pe - pelvis	**p – proximal**
hu - humerus	**ra - radius**	**d - distal**

The figures in Table 5.12 appear to indicate little change between the percentage of cattle still alive at 7 – 10 months and 12 – 19 months, so there is no evidence of a difference in the percentages of animals still alive in the first winter and second summer of life. As the age at death increases so the number of surviving animals decreases, until the last category where a larger percentage appear to be alive than in the second last category, probably reflecting the larger number of diaphyses in that fusion category. In order to overcome the problems that the varying number of diaphyses in each category causes, the categories are amalgamated to give larger fusion groups. The bigger samples thus created may give a truer reflection of the percentages that died at different age stages than the previous set of data.

Table 5.13: Cattle epiphyseal fusion, separated into early, middle and late fusing elements

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	180	84	68	7 – 19 months
Middle-fusing specimens	45	48	48	24 – 36 months
Late-fusing specimens	50	88	36	> 36 months

Table 5.13 shows that thirty-two percent have died or been killed in the first seven to nineteen months of life. The reasonably high calf mortality may indicate a wish to conserve milk for human use by rearing fewer calves (e.g. Legge 1992) although an alternative model has been suggested (McCormick 1992). While McCormick's evidence, largely based on pictorial and historical documentary sources, may fail to convince many zooarchaeologists, it is tempting to agree with his implied suggestion that it need not have been common practice to slaughter very young calves in the past in order to obtain milk from the cows. Indeed, it is difficult to imagine a farming economy before very modern times, where there would have been sufficient confidence in a high neonatal survival rate to allow deliberate killing of something as valuable as a calf. McCormick's assertion that it is a peak in slaughter of cattle in the 1 – 2 year age group (McCormick 1992, 203) that typifies a dairying economy does seem quite probable. The model would allow the weaned calf to fatten a bit on grass, but not to consume enough to develop to full maturity.

Neonatal deaths are not recorded on these tables and are listed in Table 5.14.

Table 5.14: Post-cranial neonatal bones – cattle

Total NISP (post-cranial)	No of neonatal elements (NISP)	% neonatal elements
752	21	3%

5.4.2.2 Dental evidence of ageing in cattle

Table 5.15: dental ageing evidence for cattle

Context	dp4	P4	M1	M2	M3	Age
357						Neonatal
356						Neonatal
358						Neonatal
356						Neonatal
358	a					A (0 – 1 mo)
291	g					> B (> 1 – 8 mo)
358	f					> B (> 1 – 8 mo)
361	f					> B (> 1 – 8 mo)
356		h	n	k		>D (> 18 – 30 mo)
380			osm	er		15 – 18 mo
356		unw	j			28 – 36 mo
378				f	f	F (young adult)
362				e	f	F (young adult)
361					g	G (adult)
356					k	I (senile)

Key
a – n – Grant's (1982) wear stages
A – I – Halstead's (1985) age classes
er – erupting through bone
osm – occlusal surface missing
unw – tooth almost at full height, but unworn

Table 5.15 displays the mandibular ageing data for cattle. Fifteen mandibles with ageing information were retrieved and four of these were neonatal with the deciduous premolar either not present in the mandible or not yet erupted. The deciduous premolar erupts at 0 – 3 weeks in cattle (Silver 1969). Another mandible, with dp4 present and unworn, derived from an animal that died in the first month of life. Thus, five out of the fifteen mandibles were from animals that died very young, suggesting a high mortality rate of calves. The sample size is very small and it would be unwise to surmise a deliberate cull of young animals for freeing up cows' milk for human consumption from this evidence alone. The mandible evidence does indicate a higher rate of infant mortality than is suggested by the post-cranial bones, and probably gives a more realistic picture of the situation. One very old adult was present in the mandible assemblage, at wear stage "I" with the third molar worn beyond Grant's (1982) stage "j". The presumed high quantity of sand in the machair grassland may be resulting in a faster attrition rate than would be found elsewhere, so this animal may not be as old as Halstead's (1985) term "senile" suggests. (The word "senile" is intended here to mean elderly and has no connotations of dementia or imbecility when applied to prehistoric cattle). Animals from a range of ages between the neonatal and senile individuals were also present. Three mandibles only had dp4 containing any attrition information and can only be attributed to an age of > 1 – 8 months. The fact that the permanent premolar (P4) has not replaced the deciduous one, suggests the animals are less than 28 – 36 months old (Silver 1969). It can be seen therefore, from Table 5.15 that eleven out of the fifteen mandibles retrieved derived from animals that died, or were killed, in the first three years of life. This is a high mortality rate, with 73% dead by the age of three years. The epiphyseal fusion data are different. It can be calculated from the figures in Table 5.15 that the percentage dead by 36 months would be only 37%, that is the percentage of epiphyses unfused by the age of "30 – 36 months". The lack of correlation between the two ageing methods is probably due to the loss of unfused neonatal and juvenile post-cranial bones and the mandibular evidence is probably more accurate despite the much smaller sample size.

5.4.3 Age at death of red deer

5.4.3.1 Epiphyseal fusion evidence

The epiphyseal fusion evidence for red deer is given in Table 5.16.

Table 5.16: Red deer epiphyseal fusion, separated into early, middle and late fusing elements

Epiphysis	No. fused	No. unfused	% fused	Approximate age of fusion
Early-fusing specimens	75	16	82	By 2 years
Middle-fusing specimens	142	37	79	2 – 4 years
Late-fusing specimens	76	57	57	4 – 6 years

It can be seen on Table 5.16 that the red deer are surviving to a greater age than are cattle or sheep/goat. There is considerable discrepancy in the ages of epiphyseal fusion for red deer provided by Egorov (1967) and those provided for the common domesticates by Silver (1969). It is probably worth considering the fusion data just as early-, middle- and late-fusing bones and ignoring the age figures provided. It can be seen that even so a greater percentage of the deer appear to be living to the late fusing stage. This is most likely because the animals were probably not domesticates, so not dependent on humans for subsistence. Hence, the chance of neonatal death occurring near enough to the site for the bones to be incorporated in the assemblage would be reduced. If the animals were being hunted by humans, it is probable that the older, frailer ones were caught, prime animals being more easily able to escape. Although very young animals would also be vulnerable to being hunted, it seems likely that their small size would render them as being considered not "worth" the hunting effort.

5.4.3.2 The dental evidence for age at death for red deer

No red deer mandibles with teeth intact were present in the assemblage so no red deer ageing data can be obtained from mandibular evidence.

5.4.4 Age at death of pig

5.4.4.1 Epiphyseal fusion evidence

Only forty three fragments of pig bone were retrieved of which 21 displayed epiphyseal fusion evidence. For the elements that fuse at one year old, only one out of eight epiphyses was unfused (87%). In the group of elements that fuse at between two and 2 ½ years of age 3 out of 8 were fused (38%) and in the late fusing epiphyses, fusing at 3 to 3 ½ years, 1 out of four (25%) were fused. It can be seen that the epiphyseal fusion evidence suggests the presence of a few adult pigs on the site. The numbers are small and no neonatal bones were retrieved. It seems likely that the young pig bones have been destroyed to a point beyond which they are identifiable to species due to a combination of taphonomic processes. Pigs are not kept for any secondary products (only to produce more pigs) so it is normal to slaughter them when they are young. The bones of immature pigs will be less resistant to destruction than those of older pigs. In addition, more of the body is likely to be used than may be the case with other animals slaughtered at an older age. Bones boiled for eating or soup making might be expected to be more fragile and less likely to survive taphonomic processes than those that hadn't been so treated. Consequently, bones like the foot bones, which bear more fat and muscle than do those of sheep or cattle (and were observed by the author for sale for human consumption as recently as 1992 in the UK) may well have been roasted or boiled for consumption. The cooking process may have altered the bones' physical and chemical characteristics to the extent that they may have been more strongly affected by taphonomy and hence removed from the archaeological record. Hence it is likely that young pigs are missing from the assemblage. The presence of older animals indicates that young ones would have certainly been present, pigs being prolific breeders and kept primarily, if not solely, for meat production.

5.4.4.2 Mandibular evidence for age at death of pigs

Nine fragments of mandible were retrieved of which only two had any of the molar tooth row present. One of these had M1 in wear and the other had both M1 and M2 in wear. As the first two molars erupt at 4 – 6 months and 7 – 13 months respectively (Silver 1969) this adds little to the ageing information. Most of the pig mandible fragments retrieved derived from the incisor row. The front part of the jaw in the pig is sturdier than it is in the ruminants, and the two mandibles are often fused together, so the incisor row is more likely to survive, in the pig skeleton, than in other animals of comparable size. The pig uses its snout to root around in the ground for food, which is why the front of the jaw is more robust than that of the vegetation-eating ruminants. The ruminants require great strength in their molar teeth to chew their food, so the mandibular molar row, and the corresponding part of the mandible, is stronger in ruminants than in omnivores such as pigs and humans, or carnivores such as the dog.

5.5 Taphonomic indicators

5.5.1 State of preservation of the specimens

Table 5.17 displays the state of preservation of the identified specimens.

Table 5.17: the state of preservation of the identified specimens (NISP)

a	b	c	d	total
3 (0.14%)	1121 (52.75%)	776 (36.52%)	225 (10.59%)	2125

It can be seen from Table 5.17 that the majority of fragments are well-preserved (b) and that considerably more fragments are in an extremely poor condition (d) than are in an excellent state of preservation (a). The preservation states of the fragments from each context are given in Appendix 5, table 1.

Table 5.18 displays the contexts from which more than fifty fragments were retrieved. It can be seen that context 354 contained the worst preserved bones and contexts 273, 356 and 358 the best. Contexts 273, 356 and 358 are all described as shell middens (Harding and Gilmour 2000, 94 - 95), the calcareous nature of which would assist in preserving bone, as would the practice of depositing material on a midden, rather than leaving on the floor to be crushed beyond recognition. Context 354, conversely, is described as a sticky, dark brown deposit with peat ash patches (ibid. 95), which might imply a floor deposit.

Table 5.18: State of preservation of fragments (NISP) from selected contexts

context	a	b	c	d	total	% a	% b	% c	% d
273	1	117	50	10	178	1	66	28	6
291	1	27	30	11	69	1	39	43	16
354		10	26	18	54	0	19	48	33
356		221	84	15	320	0	69	26	5
358		371	187	24	582	0	64	32	4
361		79	64	18	161	0	49	40	11
362		50	65	20	135	0	37	48	15
378		23	23	7	53	0	43	43	13
380		13	29	13	55	0	24	53	24
381		43	28	2	73	0	59	38	3
383		36	22	4	62	0	58	35	6

Table 5.19 shows the relative proportions of the different states of preservation of the taxa retrieved.

Table 5.19: The preservation of the bones from different taxa

	NISP	% a	% b	% c	% d
cattle	906	0	52	40	8
red deer	609	0	46	39	14
goat	1	100	0	0	0
horse	5	0	0	60	40
grey seal	8	0	63	38	0
otter	4	0	100	0	0
sheep	112	0	55	41	4
sheep/goat	208	0	74	22	4
common seal	6	0	83	17	0
pig	43	0	70	26	5

It can be seen that there is little difference in the relative condition of the bones from the more widely represented taxa (NISP > 100). In particular, there does not appear to be a big difference in how well the larger and smaller ruminants' bones are preserved. If anything the smaller ruminants, the sheep and sheep/goat, are better preserved than the red deer and cattle, suggesting that the shortage of these taxa in the assemblage is not due to poor preservation of the bone. It is possible that different elements preserve differentially and that is examined in Table 5.20.

Table 5.20: The preservation of the different elements (NISP) from all taxa

	a	b	c	d	total	% a	% b	% c	% d
as	0	23	55	45	123	0	19	45	37
cal	0	62	36	14	112	0	55	32	13
dph	0	40	10	4	54	0	74	19	7
fe	0	92	53	14	159	0	58	33	9
hu	0	69	78	21	168	0	41	46	13
mc	0	50	50	19	119	0	42	42	16
mn	0	106	33	3	142	0	75	23	2
mph	0	43	40	4	87	0	49	46	5
mt	0	59	56	22	137	0	43	41	16
pe	0	52	43	8	103	0	50	42	8
pph	0	49	71	11	131	0	37	54	8
ra	0	84	77	14	175	0	48	44	8
sc	0	67	39	11	117	0	57	33	9
tb	0	91	69	17	177	0	51	39	10
ul	0	43	19	8	70	0	61	27	11
teeth	3	171	27	1	202	1	85	13	0
total	**3**	**1101**	**756**	**216**	**2076**	**0**	**53**	**36**	**10**

Key
as – astragalus
cal – calcaneum
dph- distal phalanges
fe – femur
hu – humerus
mc – metacarpal
mn – mandible
mph – middle phalanx
mt – metatarsal
pe – pelvis
pph – proximal phalanx
ra – radius
tb – tibia
ul - ulna

Table 5.20 illustrates the preservation states of the elements from all taxa. The bottom row in Table 5.20 gives the total NISP for each preservation category and the mean percentages for the elements listed. Only the elements with an NISP of greater than fifty are listed here. It can be seen that teeth are better preserved than most elements, with higher scores for the good preservation categories (a and b) and lower scores for the poorer preservation categories than most of the other elements listed. Other elements that appear to survive in good condition are the mandible, probably due to the teeth within them, and the distal phalanges. The astragalus seems not to preserve well, with a higher percentage of poorly preserved specimens (category d) than any other element. The metapodials (mc and mt) seem to be in poor condition and have very similar proportions in the respective preservation categories, possibly due to their structural and morphological similarity. However, other elements that could be regarded as sharing certain morphological characteristics, such as the femur and humerus and the radius and tibia, do not exhibit such similarity in the figures for relative preservation state. Size appears not to play a great role in the condition of the bones, as the best and worst preserved (teeth and distal phalanges, compared to astragalus and proximal phalanges) are all smaller, more compact elements.

5.5.2 Staining of the bones

The scores for surface staining on bones are displayed in Table 5.21.

Table 5.21: Staining of bones from selected contexts

context	0	1	2	3	4	total	% 0	% 1	% 2	% 3	%4
273	164	7	3	2	2	178	92	4	2	1	1
291	63	3	2	1		69	91	4	3	1	0
354	41	10		1	2	54	76	19	0	2	4
356	291	17	3	1	8	320	91	5	1	0	3
358	559	17	1	2	3	582	96	3	0	0	1
361	155	4	1		1	161	96	2	1	0	1
362	125	9	1			135	93	7	1	0	0
378	47	5	1			53	89	9	2	0	0
380	50	4	1			55	91	7	2	0	0
381	65	4		1	3	73	89	5	0	1	4
383	57	4			1	62	92	6	0	0	2
Grand Total	**1617**	**119**	**13**	**8**	**20**	**1777**	**91**	**7**	**1**	**0**	**1**

Table 5.21 shows that the vast majority (91%) of the specimens retrieved have no staining present and the context with the most badly stained specimens is context 354, which has 4% of the fragments scoring a "4", indicating that 75 – 100% of the bone surface is stained. Context 354 has only 76% of the bone fragments with no staining on the surface, much lower than the other contexts listed here. As context 354 also had the least well preserved bones it seems to represent a different environment from the other contexts.

Contexts 358 and 361 contain the greatest percentage (96%) of fragments displaying no surface staining at all.

5.5.3 Gnawing marks on bones

The number and percentage of bones exhibiting gnawing marks are displayed in Table 5.22 and it can be seen that context 247 appears to contain the highest percentage of gnawed bones. However, the percentage figure is deceptive in this case as there were only six identifiable bone fragments retrieved from this context. In fact, very few bone fragments showed any sign of gnawing by carnivores such as dogs, and none showed any evidence of gnawing by rodents.

Table 5.22: Bone fragments exhibiting gnawing marks

context	no gnawed	total	% gnawed
247	1	6	17
281	1	43	2
291	1	69	1
354	1	54	2
356	1	320	0
358	5	582	1
361	2	161	1
362	3	135	2
367	2	22	9
383	3	62	5
412	1	33	3
total	**21**	**1487**	**1.41**

The lack of gnawing marks implies that the bones were deposited quickly and not left lying around to be gnawed and subsequently redeposited by dogs. The possibility that dogs did have access to the bones, but usually consumed them completely can be considered by examining which bones showed evidence of having been gnawed. This is displayed in Table 5.23, which shows the species and elements displaying gnawing marks.

Table 5.23: the species and elements displaying gnawing marks

	cattle	red deer	large ruminant	sheep	sheep/goat	small ruminant	total
as				1			1
cal	1	1					2
mph		2					2
pph		1					1
fe	1	1			1		3
hu			1				1
mc			1				1
mn	2						2
mt	1			1			2
pe		1			1		2
ra	1	1				1	3
tb					1		1
Total	**6**	**7**	**2**	**2**	**3**	**1**	**21**

Key

as – astragalus **mc – metacarpal** **pe – pelvis**
cal – calcaneum **mn – mandible** **pph – proximal phalanx**
fe – femur **mph – middle phalanx** **ra – radius**
hu – humerus **mt – metatarsal** **tb – tibia**

It can be seen from Table 5.23 that, although the figures involved are very small, the larger animals, cattle, red deer and large ruminant display slightly more gnawing marks (71% of the total gnawing marks observed) than do the smaller animal categories. If the elements are divided into large and small and a mean is calculated for each category there are slightly more instances of gnawing marks present on the larger bones (1.875) than on the smaller ones (1.5). (The smaller bones are the first four in the table). If it is assumed that the gnawing marks indicate bones that have survived carnivore gnawing then the larger bones seem to be slightly more resistant to destruction by carnivore gnawing than are the smaller ones. Only one small bone from the smaller species has been gnawed, whereas 10 of the larger elements from the larger species category have survived gnawing. It seems probable however, that not all bones were equally subjected to contact with carnivores, so the figures may just represent coincidental survival of bones with gnawing marks on them. Once again the issue of equifinality arises and it is not possible to say whether so few instances of gnawing were observed on the bones because the assemblage in general was not subjected to the attention of carnivorous animals (most likely dogs) or whether the dogs succeeded in completely destroying, or rendering unidentifiable, any bones they did chew. There were no dog bones retrieved in the assemblage from Beirgh and at least the gnawing marks indicate that dogs were present on the site. It is unlikely that any other carnivore created the gnaw marks. Foxes are found only on Skye today (Knowlton 1977, 134) and have been reported on Mull in the seventeenth century (Knowlton 1977, 32) and one was recorded on Raasay by Boswell in 1772 (ibid.). Knowlton (1977, 32) reckons the fox could swim to any of these islands and implies that it has never been present on the more remote islands. Wildcat, the only other possible British carnivore of a comparable size to dog, is similarly not recorded in the Western Isles other than on Skye where they are reported to have existed up to the end of the nineteenth century (Knowlton 1977, 162). In any case it seems unlikely that bones chewed by such normally timid, shy creatures as foxes or wildcats would end up in the kitchen midden and other deposits so close to human habitation.

5.5.4 Butchered bones

Butchery marks were recorded according to whether they were likely to have been caused by primary butchery, dismembering marks, or by secondary butchery, classed as filleting marks. In the first instance a simple quantification of the number of identifiable specimens displaying butchery marks of any sort was carried out. The results are shown on Table 5.24.

Table 5.24: bones displaying butchery marks

	NISP	No. butchered	% butchered
cattle	906	162	**18**
red deer	609	113	**19**
horse	5	1	**20**
grey seal	8	3	**38**
sheep	112	22	**20**
sheep/goat	207	26	**13**
common seal	6	3	**50**
pig	43	7	**16**
total	**1896**	**337**	**18**

It can be seen that of the four mammal taxa present in quantities greater than 100 (NISP), cattle, red deer, sheep and sheep/goat, that the percentages of butchered specimens is similar. The figure for sheep/goat is slightly lower than the others, but this may be caused by the fact that some elements will be comparatively over-represented in the "sheep/goat" category, and such elements may be less likely to display butchery marks. When it is considered that butchery marks represent mistakes made during carcass or food preparation the percentage of butchered bone in the Beirgh assemblage is high. For example, a dismembering mark is recognised by being located near the articulating joint of the bone, and indicated that the blade has missed the joint at which it is aimed. Likewise, a filleting blade would be aiming to cut through muscle and flesh and not to hit bone.

5.5.4.1 Butchery marks on horse bones

There is evidence of butchered horse bone at Beirgh. Only five fragments of horse bone were retrieved, and only the tibia and radius were represented. All the bone fragments could have derived from one individual. The butchered bone was a fragment of proximal radius that had three filleting marks on zone 5 (Dobney and Rielly 1988). The fragment comprised only the very proximal end of the bone and may represent material that survived being fed to dogs (although no gnawing marks were observed on the bone). Consumption of horsemeat by humans cannot be ruled out, but similarly cannot be persuasively argue for on the basis of so few retrieved bone fragments.

5.5.4.2 Butchery marks on seal bones

A relatively high percentage of the retrieved seal bones display butchery marks, suggesting the animals were used by humans for some purpose. The butchered elements were a mandible fragment, a femur fragment, a complete femur, ulna and near complete scapula and a fragment of radius. All specimens were in good or fair condition ("b" or "c") and displayed no signs of staining or of carnivore gnawing.

The butchery marks on the other, more commonly represented species will now be discussed.

5.5.4.3 Butchery marks on pig bones

The seven butchered specimens from pig include two complete astragali, two nearly complete unfused calcaneum, two mandible fragments and one scapula fragment. The butchery marks on all but one mandible fragment were classified as being dismembering marks. On the exceptional mandible fragment, the nine butchery marks have been described as being filleting marks, but their location right at the exterior edge of the mandible (*Corpus madibulae*, Zone 7, Dobney and Rielly 1988, 84) suggests they may have been wrongly attributed.

5.5.4.4 Butchery marks on cattle bones

The butchered specimens deriving from cattle were from almost all elements of the limbs and the mandible. Butchered metatarsal, humerus and metacarpal were the most abundant in the assemblage. The smaller elements of the leg and foot, the astragalus, calcaneum, the proximal and middle phalanges displayed an overwhelming preponderance of dismembering marks relative to filleting marks. Some butchering marks described as "chop marks" were also present on these bones and one calcaneum had eleven filleting marks on the proximal half of its shaft (Zone 2, Dobney and Rielly 1988). No other filleting marks were noted on these smaller bones.

Ten fragments of cattle scapula showed signs of having been butchered. No dismembering marks were recorded, but two scapulae displayed chop marks that may have resulted from carcass dismembering. Three scapulae were unfused so derived from juvenile animals of less than 7 – 10 months at the time of death. The three butchered scapulae derived from a minimum of three animals, and provide evidence for the consumption of young animals, killed a long time before they had attained optimum weight.

Seven fragments of cattle pelvis displayed butchery marks including three fragments of unfused pelvis, indicating the consumption of juvenile cattle (younger than 7 – 10 months), before they had attained optimum meat weight. The immature, unfused pelvis fragments derived from a minimum of two animals, so the butchery evidence does not suggest widespread consumption of young cattle. However, together with the evidence from the butchered scapulae above, it may indicate a liking for the meat of young animals. Consumption of juveniles may in turn suggest that not all neonatal death in calves was due to loss through sickness or starvation.

The long bones of the upper limbs displayed a variety of types of butchery marks. Twenty-three fragments of cattle humerus displayed butchery indicators, mainly filleting marks, although four showed dismembering marks on the unfused distal end. As with the pelvis and scapula the butchering of animals before fusion of the early-fusing distal humerus indicates the consumption of juvenile cattle probably before they had attained prime meat weight. Again the MNI is low, possibly only one animal being represented with the fragments of butchered distal cattle humerii retrieved. However, as the four unfused butchered distal humerii from cattle were retrieved from three different contexts it seems unlikely they all derived from the same animal.

Only five fragments of cattle femur showed signs of having been butchered, one was a fragment of distal femur, which had the epiphysis fused, indicating a mature animal of between three and a half and four years at death. Only one fragment had dismembering marks on it, all other signs of butchery were interpreted as being filleting marks. One fragment of ulna was heavily butchered, with five chop marks near the articulation with the radius.

Twelve fragments of cattle radius had been butchered and a mixture of filleting, dismembering, chop and "knife" marks were observed. "Knife" marks are cuts that cannot be attributed to any of the other classes of butchering mark. Two heavily butchered radius fragments with unfused proximal epiphyses support the observation made above about the consumption of juvenile animals.

Twenty-one fragments of cattle tibia were butchered and displayed a variety of indicators. One has three oddly shaped holes in the proximal shaft, possibly indicators that the bone was selected for manufacturing purposes then later rejected.

Twenty metacarpals and metatarsals were also butchered, including one metacarpal and two metatarsals from neonatal animals. A mixture of types of butchery marks was present on the metapodials.

Eight cattle mandibles contained knife marks, most of which could not be interpreted as either filleting or dismembering marks.

The butchered bones were generally unstained and in good or fair condition (preservation states b and c) as is shown in Table 5.25. Table 5.25 shows the NISP of butchered elements from cattle categorised first by the extent to which they are discoloured, then by the preservation state they are in. It can be seen that the majority exhibit no discoloration and are not poorly preserved (category d). The two stained fragments are in fairly poor condition (category c).

Table 5.25: the condition of the butchered cattle bones (NISP)

staining	0				1			2		3		GRAND TOTAL
preservation	b	c	d	T	b	c	T	c	T	c	T	
Astragalus	1	3		4								**4**
Calcaneum	5	2		7	1		1					**8**
Femur	4	1		5								**5**
Humerus	15	7	1	23								**23**
Metacarpal	3	12	1	16	1	2	3	1	1			**20**
Mandible	4	4		8								**8**
Phalange 2	6	2		8						1	1	**9**
Metatarsal	5	16	2	23		3	3					**26**
Pelvis		6		6	1		1					**7**
Phalanx 1	1	7		8								**8**
Radius	7	4		11	1		1					**12**
Scapula	6	2		8	2		2					**10**
Tibia	8	8	3	19	1	1	2					**21**
Ulna	1			1								**1**
Total	**66**	**74**	**7**	**147**	**7**	**6**	**13**	**1**	**1**	**1**	**1**	**162**

Key

Staining:

0 – no visible marking or staining on the bone fragment

1 – less than 25% of the bone fragment surface stained

2 – 25 – 50% of the bone fragment surface stained or marked

3 – 50 – 75% of the bone fragment surface stained or marked

4 – more than 75% of the surface of the bone fragment stained or marked

Preservation:

a – bone in "new" condition, surface shiny and complete

b – bone in good condition, surface dull but largely complete

c – bone in poor condition, less than 50% of the surface flaking or crumbled off

d - bone in very poor condition, more than 50% of the surface flaking or crumbled off

T – total

Table 5.26 illustrates the percentage of cattle elements butchered (NISP).

Table 5.26: The percentage of cattle elements butchered (NISP)

element	Total NISP retrieved	NISP butchered	% butchered
Astragalus	40	4	10
Calcaneum	43	8	19
Femur	47	5	11
Humerus	49	23	**47**
Metacarpal	70	20	29
Mandible	70	8	11
Phalanx 2	66	9	14
Metatarsal	80	26	**33**
Pelvis	44	7	16
Phalanx 1	88	8	9
Radius	62	12	19
Scapula	26	10	**38**
Tibia	63	21	**33**
Ulna	35	1	3
total	783	162	21

It can be seen from Table 5.26 that the most frequently butchered elements among the cattle bones in the Beirgh assemblage are the humerus, scapula, tibia and metatarsal.

5.5.4.5 Butchery marks on the red deer bones

The condition of the butchered red deer bones is shown in Table 5.27 below

Table 5.27: the condition of the butchered red deer bones (NISP)

Staining	**0**				**1**			**2**		**3**		
Preservation	**b**	**c**	**d**	**T**	**b**	**c**	**T**	**b**	**T**	**b**	**T**	**total**
Astragalus	1	3		4								**4**
Calcaneum	2	4		6		1	1					**7**
Epistropheus			1	1								**1**
Femur	6	5		11	2		2					**13**
Humerus	4	14		18	3		3					**21**
Metacarpal	2		1	3								**3**
Metapodial		1		1								**1**
Metatarsal	3			3								**3**
Pelvis	3	2		5		1	1					**6**
Phalanx 1	2	1		3								**3**
Radius	8	5		13		1	1					**14**
Scapula	4	6		10	2	1	3	1	1			**14**
Tibia	12	7		19						1	1	**20**
Ulna	1	2		3								**3**
Grand Total	**48**	**50**	**2**	**100**	**7**	**4**	**11**	**1**	**1**	**1**	**1**	**113**

Key as in Table 5.25

Table 5.27 presents the number of butchered elements of red deer in the assemblage and the general condition they are in. Butchery marks were present on almost all elements with the exception of the second and third phalanges and the (under-represented) mandible. More butchered fragments of humerus and tibia were present in the assemblage than of other elements. The total number of butchered fragments (NISP) of each element is given in the final column of Table 5.27, which also indicates the general condition of the bones and whether they were discoloured or not. The small bones of the foot and leg predominantly displayed dismembering marks. Two proximal phalanges displayed filleting marks, one with 5 filleting marks and one with15 cuts described as "?fm" which might represent bone working as the proximal phalanx of a red deer would hardly carry enough meat to merit such effort on filleting.

One epistropheus (axis vertebra) bearing a chop mark was retrieved. The chop mark may represent beheading of the animal.

The butchered scapulae have a mixture of chop, dismembering and filleting marks and one bears a very long thin knife mark on zone 5 (Dobney and Rielly 1988). Only one butchered scapula is unfused as might be expected with an early-fusing element like the scapula. Similarly, there is only one unfused distal humerus (fusing at 2 – 3 years) among the butchered red deer elements, but four fused proximal humerii fragments, that fuse at five to six years. The presence of one unfused proximal humerus fragments in the assemblage may indicate a prime age animal. No butchered radius fragments were retrieved, so no ageing information can be obtained from them. The butchery marks on the radius fragments were predominantly filleting marks and non-specific knife marks, with only one specimen displaying a chop mark and two specimens displaying dismembering marks out of the fourteen butchered red deer radius specimens retrieved. Three ulna specimens displayed butchery marks, all near the proximal end where the bone articulates with the radius. Two specimens displayed filleting marks and one displayed chop marks. Three red deer metacarpals were butchered, all were filleting marks and all were on the diaphysis of the bone.

Fewer butchered bones from the hind limb of the red deer were retrieved than from the forelimb. The fragments from the pelvis showed a mixture of markings including one wide cut mark and three specimens showed knife marks that could not be attributed to either dismembering or filleting activity. The eleven femur fragments that were butchered displayed a mixture of filleting, dismembering and chop marks, with filleting marks in the majority as might be expected in a high-meat bone such as the femur. Twenty butchered fragments of tibia were present in the assemblage and fifteen of them displayed marks interpreted as filleting marks, while three had dismembering marks and one had large chop mark across the proximal epiphysis. The three fragments of butchered metatarsal showed only filleting marks, and, like the metacarpal, all were on the diaphysis of the bone.

It can be seen that more tibia and humerus bones display butchery marks than the other elements. However, there were such discrepancies in the numbers of the various elements retrieved that it is worthwhile comparing the number of butchered red deer element fragments with the total numbers of fragments retrieved. This information is displayed in Table 5.28.

Table 5.28: The percentage of red deer elements butchered (NISP)

element	Total NISP retrieved	NISP butchered	% butchered
Astragalus	57	4	7
Calcaneum	47	7	15
Epistropheus	3	1	33
Femur	62	13	21
Humerus	72	21	**29**
Metacarpal	15	3	20
Metatarsal	30	3	10
Pelvis	24	6	25
Phalanx 1	11	3	27
Radius	67	14	21
Scapula	58	14	**24**
Tibia	80	20	**25**
Ulna	20	3	15
total	546	112	21

Disregarding the elements that are under-represented, such as the epistropheus (axis), metacarpal and the first phalanx, it can be seen that the humerus, tibia and scapula are proportionally quite heavily butchered. Conversely, the astragalus and calcaneum show proportionately less butchery evidence. The low incidence of butchery on the metapodial bones is interesting and may reflect the overall low representation of the two elements. The mean number of specimens per element for the elements listed in the above table is 42 and both the metatarsal and metacarpal figures fall well below that, indicating they are under-represented in the assemblage. They may have been removed for bone working, as they are straight, reasonably structurally dense bones well suited for manufacturing tools, pins or decorative items.

5.5.4.6 The butchery of sheep/goat bones

The bones from sheep and sheep/goat were combined for the purposes of comparing the butchery of the various elements present.

Table 5.29: the butchery of sheep/goat bones

Element	Total butchered	Total sheep/goat elements	% butchered
Astragalus	4	16	25
Femur	7	31	23
Humerus	2	18	11
Metacarpal	11	24	**46**
Mandible	5	34	15
Metatarsal	7	16	44
Radius	6	20	30
Scapula	2	15	13
Tibia	4	20	20
Total	**48**	**194**	**25**

Fewer sheep/goat bones were present in the assemblage than the two larger species so the number of butchered bone fragments is also lower. This makes it more difficult to be confident about the significance of the percentages of butchered elements presented in Table 5.29. However, it can be seen that a large percentage of both metapodials is highly butchered. The radius also exhibits a high percentage of butchery marks. The astragalus has exactly the same percentage of butchered elements retrieved as for the sheep/goat elements together (25%). This is not the case for the cattle bones (Table 5.26) or the red deer assemblage (Table 5.28) where the percentage of butchered astragalus bones is below the "average" percentage of all elements for the species.

5.5.4.7 The butchery of all taxa

The overall representation of the butchered elements of all species present in the assemblage from Beirgh is presented in Table 5.30. The humerus, tibia, radius and scapula can be seen to be the most widely butchered elements in the retrieved assemblage and the astragalus, calcaneum and epistropheus the least well –represented among butchered bones from all species. It is probably a more realistic to calculate the percentages of butchered elements, so this information is presented in Table 5.31.

Table 5.30: All butchered bones (NISP)

Staining	0				1			2			3			4		grand
Preservation	b	c	d	total	b	c	T	b	c	T	b	c	T	c	T	total
Astragalus	4	10		14												14
Calcaneum	11	7		18	1	1	2									20
Epistropheus			1	1												1
Femur	17	8		25	2		2									27
Humerus	21	22	1	44	3		3									**47**
Metacarpal	10	17	2	29	1	2	3		1	1				1	1	34
Mandible	11	5		16												16
Phalanx 2	6	2		8								1	1			9
Metatarsal	12	18	2	32		4	4									**36**
Metatarsal III		1		1												1
Pelvis	3	8		11	1	1	2									13
Phalanx 1	3	8		11												11
Radius	22	13	1	36	1	1	2									38
Scapula	14	9		23	4	1	5	1		1						29
Tibia	25	15	3	43	1	1	2				1		1			**46**
Ulna	3	2		5												5
Grand Total	**163**	**146**	**10**	**319**	**14**	**11**	**25**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**1**	**349**

Table 5.31: The percentage of butchered bones from all taxa

Element	Total NISP retrieved	NISP butchered	% butchered
Astragalus	123	14	11
Calcaneum	112	20	18
Epistropheus	11	1	9
Femur	159	27	17
Humerus	168	47	**28**
Metacarpal	119	34	**29**
Mandible	142	16	11
Phalanx 2	87	9	10
Metatarsal	137	36	**26**
Pelvis	103	13	13
Phalanx 1	131	11	8
Radius	175	38	22
Scapula	117	29	25
Tibia	117	46	**39**
Ulna	70	5	7
total	1771	346	20

The percentages of butchered bones are generally high at Beirgh and the elements that have more than 25% of their fragments butchered are shown in Table 5.31 in bold type. As with the red deer butchery data the tibia, scapula and humerus are highly butchered in the figures for all the taxa together. The metacarpal and metatarsal show higher proportions of butchered fragments when the bones from all species are considered than is apparent from the red deer data, supporting the hypothesis that something different is happening with the red deer metapodials. The difference could be caused by the under-representation of the metapodials of red deer compared to those of the other species. Such under-representation might arise because the metapodials were not brought onto site in the first instance, or because they were removed from the assemblage as a useful raw material.

5.6 Association of bones with specific contexts

The following contexts had only one fragment of identifiable mammal bone within them - 53, 65, 146, 208, 213, 244, 256, 293, 297, 305, 332, 368, 386, 398, 428 and 662. Eleven contexts had between two and ten identifiable mammal bones within them. They were 236, 247, 258, 271, 290, 351, 357, 360, 364, 376 and 385. Only five contexts contained more than one hundred identifiable mammal bones; 273, 356, 358, 361 and 362. The remaining eighteen contexts produced between ten and one hundred identifiable specimens.

None of the contexts within Phase 5 were noted as containing bones within them when they were excavated, other than being described as middens. No caches or pits with bone were noted in this occupation phase. For that reason the assumption is being made here that no contexts within this phase contain burials or other deposits that might be interpreted as structured deposition. As the bone assemblage from the site appears to represent domestic waste deposits it can be hypothesised that kitchen or industrial waste was dumped in inaccessible places, such as wall cavities (which context 358 represents), with the main objective being to remove the waste material from the living quarters. Due to the small size of the site's occupation area, and the fact some contexts are believed to represent redeposited material, no investigation of spatial variation in bone disposal was investigated during this study.

5.7 Measurements of mammal bones retrieved from Beirgh

Measurements were taken from a selection of elements retrieved from Beirgh. Due to constraints of time not all elements were measured. Only fused and complete bones and epiphyses were measured. Measurements follow von den Dreisch (1976). The measurements are displayed in Table 5.32.

Table 5.32 Measurements of mammal bones from Beirgh (mm)

ASTRAGALUS

cattle	**Bd**	**GLl**	**GLm**	**Dl**
mean	37.86	59.82	55.05	32.87
min	34.40	55.00	50.30	28.10
max	41.00	63.30	59.40	35.00
N	18.00	18.00	17.00	18.00
st dev	1.80	2.12	2.30	1.62
red deer	**Bd**	**GLl**	**GLm**	**Dl**
mean	26.63	42.02	39.54	22.90
min	22.00	39.20	36.10	21.50
max	30.40	45.40	42.10	25.70
N	20.00	21.00	19.00	21.00
st dev	2.00	1.87	1.60	1.17
sheep	**Bd**	**GLl**	**GLm**	**Dl**
mean	16.03	26.66	26.18	13.92
min	11.40	24.00	24.00	11.10
max	19.10	29.20	28.00	15.20
N	10.00	10.00	8.00	9.00
st dev	2.02	1.98	1.52	1.27

FEMUR

cattle	**Bp**	**Bd**	**sheep**	**Bp**	**Bd**
mean	103.20	83.20	mean	38.00	34.00
min	103.20	82.70	min	38.00	34.00
max	103.20	83.70	max	38.00	34.00
N	1	2	N	1	1
st dev	0	0.71	st dev		
red deer	**Bp**	**Bd**	**pig**	**Bp**	**Bd**
mean		54.48	mean		48.90
min		50.70	min		48.90
max		57.00	max		48.90
N		4	N		1
st dev		2.87	st dev		

HUMERUS

cattle	**Bd**	**BT**	**red deer**	**Bd**	**BT**
mean	71.70	64.94	mean		41.50
min	69.60	63.50	min		39.00
max	75.60	66.20	max		46.40
N	4	5	N		14
st dev	2.68	1.23	st dev		2.33
sheep	**Bd**	**BT**	**Bp**	**Dp**	
mean		28.10	34.00	36.10	
min		23.50	34.00	36.10	
max		38.50	34.00	36.10	
N		7	1	1	
st dev		5.4			

Key
st dev – standard deviation N – number of specimens measured

Table 5.32 (cont'd) Measurements of mammal bones from Beirgh (mm)

METACARPAL					
cattle	**Bp**	**Bd**	**GL**	**SD**	**DD**
mean	47.95	51.27	169.00	27.68	20.08
min	47.45	47.60	168.00	26.45	19.50
max	48.45	54.05	170.00	28.90	20.65
N	2	9	2	2	2
st dev	0.7	2.1	1.4	1.73	0.81
red deer	**Bp**	**Bd**	**sheep**	**Bp**	**Bd**
mean		33.35	mean		22.28
min		32.15	min		21.25
max		34.55	max		23.60
N		2	N		2
st dev		1.7	st dev		0.64

METATARSAL						
cattle	**Bp**	**Bd**	**red deer**	**Bd**	**sheep**	**Bd**
mean	42.70	50.29	mean	34.38	mean	22.28
min	42.70	45.70	min	33.00	min	21.25
max	42.70	60.45	max	35.75	max	23.60
N	1	7	N	2	N	4
st dev		5.43	st dev	1.95	st dev	0.98

Key
st dev – standard deviation N – number of specimens measured

Insufficient measurable bones were retrieved from the assemblage to enable any metrical analysis that might have revealed the presence of the different sexes of domestic mammal (male, female, castrate).

The astragalus measurement (mean) for sheep fall within the range obtained from the specimens excavated at Howe (Smith 1994, Table 44mf). The red deer astragalus measurements at Beirgh are slightly below the range reported at Howe, which is GLl 42 – 53mm (ibid.), compared with the Beirgh range above of 39 – 45mm. However as the astragalus is not a bone that fuses some of the smaller bones may be from immature animals, although an effort was made not to measure obviously neonatal bones.

The measurements of femur bones from Beirgh all fall within the ranges published for the Howe bones (Smith 1994, Table 44mf), as do the humerus measurements for which *comparanda* are available. Likewise the metapodial measurements obtained from Beirgh all fall within the range obtained from the much larger sample of measured bones from Howe. Therefore, it can be concluded that the animals at Beirgh were similar to those at Howe in Orkney.

Where comparable measurements are published the mean figures given for cattle and sheep from sites in the Western Isles (Mulville 1999; 255, Table 10.20; 257, Table 10.22) almost all fall within the range obtained from the Beirgh measurements. The exception is one cattle astragalus measurement from Sollas, North Uist, which is smaller than the minimum measurement obtained from Beirgh. As the astragalus does not fuse this measurement may have been taken from an immature animal. It therefore appears that the size of the animals at Beirgh was typical for prehistoric Atlantic Scotland.

5.8 Conclusion

The mammal bone assemblage from the final cellular occupation phase at Loch na Beirgh contained cattle, red deer, sheep, pig, grey and common seal, horse, otter and goat bones. Cattle bones predominate when quantified by NISP or weight, but red deer are most abundant when quantified by MNI. The figures for the larger species may be artificially high due to greater fragmentation of larger bones and a count of homologous elements goes some way to redressing this, showing sheep/goat as proportionately more abundant than in the other quantification methods. It is probable that the homologous element method results are the most realistic representation of the death assemblage, and, even they are probably under-representing sheep/goat. The relative lack of sheep/goat bones is believed to be due to the lack of sieving of excavated deposits, which will mask any cultural effects on the relative abundance of the different species.

The element representation figures support the hypothesis that the retrieval taphonomy is an important influencing factor in the bones retrieved as there is a relative lack of small bones such as the phalanges and vertebra from all three of the main taxa. Conversely the similarly small astragalus and calcaneum are well represented in cattle, and the astragalus is relatively over-represented in sheep/goat and red deer. It is believed the relative over-representation of these elements might be due to their robust and distinctive morphology, which will increase their chances of surviving taphonomic processes and of being recognised during excavation.

The body part representation analysis indicates some extra shoulders of venison may have been imported onto site. The other taxa appear to have been brought to site as whole animals, whether alive or dead. Similarly the deer are represented by a higher proportion of high meat-yielding elements than are the other taxa, supporting the hypothesis that the deer are treated differently from the sheep/goat and cattle. The head and feet bones of red deer are greatly under-represented relative to the meat-bearing bones, supporting the hypothesis that joints of meat may have been imported. No strong correlation between bone utility or structural density and element representation was noted.

The age at death data suggests that deer are not domesticated, as a high proportion of the assemblage seems to derive from older animals, probably past their prime age for consumption, which is more likely to reflect a hunting economy than one based on husbandry. The sheep/goat ageing evidence indicates high losses of young animals, particularly when the mandibular evidence is considered. Likewise, cattle ageing data from mandibles reveal more neonatal deaths than the fusion evidence suggests, with eight out of fifteen mandibles derived from animals dead in the first year of life. There is evidence of mature pig on site, most probably a breeding animal.

The study of the taphonomic indicators showed that most fragments were reasonably well preserved (b) and that preservation was not affected by bone size or morphology. Most specimens were unstained, and context 354 had the greatest proportion of stained bones, suggesting again that it was a different type of deposit from the other deposits that yielded many (>50) identifiable bones. Very few bones exhibited signs of carnivore gnawing and no signs of rodent gnawing were noted on the bones from Beirgh. Butchery marks were analysed in some detail for the taxa that displayed them. Butchered horse and grey seal bones were retrieved. There is butchery evidence for consumption of young calves (scapula and pelvis unfused). For cattle bones the scapula, humerus, tibia and metatarsal display relatively higher amounts of butchery marks than do the other elements. In the case of red deer the scapula, humerus and tibia display most butchery marks, but the relative under-representation of the red deer metapodials in the assemblage may be the reason for the difference. The sheep/goat data indicate metacarpals are heavily butchered, but the small sample size may be affecting the results, as the scapula, humerus and tibia are only present in amounts smaller than the mean for all elements. Grouping all elements together shows that humerus, metapodials and tibia display the most butchery marks.

No attempt to analyse differences in element or species representation according to site area or context was made due to the small occupation area of the site and the relatively large number of contexts that produced very few bones. The observation was made that the best-preserved bones were retrieved from contexts described as shell middens.

The size of the animals at Beirgh was similar to those elsewhere in Atlantic Scotland according to the published measurements available.

Chapter 6: The implications of the animal bone analysis from Bostadh and Beirgh

6.0 Introduction

Chapter 6 examines the findings from the bone assemblages retrieved from Bostadh and Beirgh. The ecology of the most abundant animal species found on the sites is discussed with consideration of the implications for the interpretation of the analysis.

The findings from Bostadh and Beirgh are then compared to each other. As another assemblage of mammal bones from a later phase at Beirgh has been analysed by another worker the results obtained are described briefly with a view to comparing them with the results in this study. The site of Cnip, a wheelhouse complex is introduced and the implications of the animal bone report discussed. Finally, the three sites are considered together in the context of Atlantic Scotland.

6.1 Ecology of the animals on site

It is perhaps worth clarifying what is meant by the terms "wild" and "domesticated". Humans and other animals relate to each other in many ways, as commensals, parasites, vermin, and pets, and there is no reason to assume constancy over time, or indeed space, for any of the relationships. Distinctions between the various relationships between humans and other animals are difficult to define, and, probably impossible to interpret from the archaeological record (O'Connor 1992, 109).

The study of the human domestication of animals; why it happens; how it happens; and when it started; is a huge subject on which much has been written (e.g. Bokonyi 1989; Budiansky 1992; Clutton-Brock 1992, 1994, 1999; Darwin 1859, 1875; Ducos 1989; Ingold 1980, 1994). The view subscribed to here is that domestication can be regarded as an evolutionary, rather than a revolutionary process. That is, there are many levels of domestication, and the degree of domestication of any animal will vary according to both biological and cultural processes (Clutton-Brock 1992).

Human and animal relationships vary from the nomadic following of herds of reindeer or llama, (e.g. Ingold 1980) to the recently cloned sheep, animals whose lives are entirely controlled by human action. While the reindeer obviously are not domesticates, and the sheep obviously are, there is a grey area in between, where the status of the animal is debatable. A useful definition of a domestic animal is given by Clutton-Brock (1999, 32) as "one that has been bred in captivity for purposes of economic profit to a human community that maintains total control over its breeding, organisation of territory, and food supply". Examples where there may be some doubt as to the level of domestication would include animals in zoos, some of which breed and some of which do not. Another area of ambiguity would be modern red deer herds in the Scottish highlands. They are not fully wild animals living an entirely natural life, since they are protected from predators and often receive dietary supplements. They are perceived as owned by the landowner (who controls their predation by people who pay to hunt them and can only do so at particular times). Therefore, the deer provide "economic profit to a human community". Yet they largely control their own territory; find most of their own food supply; and select their own breeding partners (albeit from stock depleted by selective human predation of stags in prime breeding condition). They are not separate, genetically, from red deer elsewhere in the world. In some ways they are controlled by humans and in other ways they are not. There is, therefore, a need for another word that falls between wild and domestic, which would cover situations such as the red deer, and, for instance, Amazonian tree frogs in the zoo. Clutton-Brock uses the term, "exploited captives" a category that includes camels, elephants and cats, and she defines the term as animals whose breeding remains more under the influence of natural rather than artificial selection (Clutton-Brock 1999, 130). The term does not imply that deliberate selective breeding is never carried out, the example of racing dromedaries is given (ibid.) and the great variety of breeds of cat would be another one. Exploited captives are usually animals so well adapted to their environment that selective breeding would not improve their usefulness to humans. The unique role of cats in human society is frequently commented on (e.g. Serpell 2000; Turner 2000; Turner and Bateson 2000). Clutton-Brock (1999, 131) suggests they might be better termed an "exploiting captive", a sentiment shared by O'Connor (1992, 112; 2000, 149) and other cat owners. Cats, camels and tree frogs are not pertinent to the current study, but have been discussed as an illustration of how difficulties arise in classifying the level of domestication to apply to an animal species.

In Lewis the assumption is made that cattle, sheep, horses and pigs were domesticated by the Late Iron Age. In some ways the isolation of the island group make this an easier assumption to make than elsewhere in world prehistory. All mammals must have been introduced to the island, because during the most recent episode of glaciation ice covered the islands (von Weymarn 1979) and would have killed the existing fauna. The islands are too distant to be reached by proficient swimmers such as deer, even with island hopping, (Serjeantson 1990). This poses a problem with red deer, which must have similarly been introduced to the islands, possibly by Mesolithic people (Serjeantson 1990) although it can be assumed that red deer in the past, as today, lacked the characteristics that make for successful domesticates. In common with gazelles and antelopes, deer are highly adapted for immediate flight at the first sign of danger and, being less gregarious than sheep or cattle, will not thrive if kept herded closely together (Clutton-Brock 1999, 9). Their social behaviour is, therefore, incompatible with that of the humans who wish to keep them (Clutton-Brock 1992, 80). It seems unlikely red deer have ever been true domesticates but they may have been treated similarly in the past to how they are treated today.

As they are not captives the term "exploited captives" as used by Clutton-Brock (1999, 130) is not appropriate, so the term "managed animals" will be used here. Management will be defined as any human behaviour that interferes with the natural social and biological habits of the animal population. Killing, as an act in itself, does not denote animal management, the presence of guillemot on a site does not indicate management of the birds, for instance; but culling, the selection of animals for killing based on age or size would be a sign of management. There is no clear distinction between hunting purely "wild" animals and resource management; various hunter-gatherers can be argued to manage the resource they exploit. Most notably, in this regard, the Cree of Northern Canada (Ingold 1994, 9) believe that animals present themselves to be hunted, so their soul might be freed to begin life in the flesh anew, following consumption of the meat. The animal will not return to the hunter (in its next incarnation) if the hunter has treated it badly in a past life. Examples of such maltreatment would include; lack of respect in butchering, consuming and disposing of the carcass; failure to share the flesh with others; and unnecessary waste (killing beyond what is needed). By such belief systems people can protect the animals in their ecosystem and safeguard the resource. Like all activities based on human decision making and belief systems, management of animals will be difficult to detect in the archaeological record. However, the persistent survival of red deer on or near the Bhaltos peninsula over the centuries that the sites of Cnip and Beirgh were occupied argues strongly for some sort of management, if only because they were not hunted to extinction as appeared to be the case on Orkney (Smith et al. 1994).

There is considerable evidence that the people living in Beirgh and Bostadh made use of wild or natural resources in the area (Church 2002; Cerón-Carrasco 2002; Cerón-Carrasco et al. forth.). Red deer, most likely a non-domesticated animal in the Late Iron Age, appears from the mammal bone evidence to have played an important part in the diet, as was also the case at Cnip (McCormick, forth.). Arguing from an essentially environmentally determinist viewpoint, McCormick (forth.) reckons that red and roe deer, which both feature prominently in the assemblages from Early Iron Age to Norse deposits at Dun Mor Vaul on Tiree must have been "domesticated animals" (McCormick forth.5). He bases this somewhat controversial view on the inherent unsuitability of the natural environment of Tiree to sustain herds of red and roe deer, due to the smallness of the island and the palynological evidence for a lack of woodland cover in the Iron Age. Roe deer in particular favour a woodland environment and McCormick argues that, even if pockets of woodland were present on Tiree in the Iron Age, the survival of roe deer herds over such a long period implies careful conservation and sensitive culling of the herds. He also argues that it is likely that humans introduced deer and other large mammals to the islands, a hypothesis supported by other research (Serjeantson 1990). McCormick cites medieval documentary evidence for feeding deer with hay in Stirling, albeit fallow deer for hunting for sport. Similarly, red deer in the Scottish Highlands are fed supplementary hay in harsh winter weather today. Whether the provision of occasional supplementary food can be regarded as farming is not addressed by McCormick, and a better term might be management, which, as noted above, would correspond to how Highland deer herds have co-existed with people today and in the more recent past. Free from persecution by non-human predators they are often fed during inclement weather and, generally, culled when their numbers threaten to overwhelm their environment. (The apparent failure of this management to control red deer population numbers has led, in recent years to calls for re-introduction of a natural predator, the wolf).

The idea that red deer and humans have co-existed in different ways in the past, from how they do today, has been implied by several other workers. Jarman (1972) has suggested that during the Mesolithic and Neolithic red deer were semi-domesticated or husbanded by people who culled them selectively. The presence of foetal red deer remains at Quanterness Cairn in Orkney led to the conclusion that the red deer population in Orkney was under the direct control of humans (Clutton-Brock 1979; cited in Smith 1994, 149). At Howe, in Orkney the kill-off pattern indicates selective culling, with many deer being killed in the first year of life and a high proportion of deaths in the age range 4 – 8 (Smith 1994, 145). This reflects modern killing patterns in deer, with the average age of the hind cull being between 4 – 5 years and that of stags between 6 – 7 years. Pathological evidence implies that red deer in Orkney in the Iron Age suffered from a restricted gene pool which may have contributed to the decrease in their numbers and their eventual extinction in Orkney in the Iron Age (Smith 1994, 139).

In order to investigate whether the archaeological evidence supports McCormick's assertion that there is evidence for the farming of red deer in the Bhaltos peninsula, where Beirgh is located, it is necessary to know something of the ecology of red deer and the environments to which they can adapt. Such knowledge will help assess whether the environment on the Bhaltos peninsula, and on Greater Bernera, could have supported a sustainable red deer herd living in a "wild", unmanaged state or whether the herd would have been dependent on human intervention for their survival.

6.1.1 The ecology of red deer

Red deer (*Cervus elaphus* L. 1758) and North American wapiti (*Cervus canadensis* Erxleben 1777) are now usually regarded as being the same species (Red Deer Commission 1981, 10; Clutton-Brock et al. 1982, 10) and are distributed around the temperate zone of the Northern Hemisphere from latitude 30° to 65° (Red Deer Commission 1981). Scottish red deer are at the northern end of this range and have adapted to conditions quite different from those favoured by red deer elsewhere in the world. Over most of their range they are generally a woodland species, being found in deciduous and coniferous woods varying from dry Mediterranean scrub through to woody marshes (Red Deer Commission 1981, 10).

The progressive loss of Scottish woodland has led to the animals adapting to living on hill and moorland. It is believed that the hill-land provides as great security for the animals as the woodland does. The treeless hill slopes allow the deer to see any danger from far away, so they can compensate for their own increased visibility (Red Deer Commission 1981, 11) whereas animals living in a woodland habitat depend on keeping themselves hidden from any danger. Red deer prefer open woodlands or a woodland fringe habitat, and rarely live in the middle of dense forest (Red Deer Commission 1981, 10; Callandar and MacKenzie 1991, 54).

Modern red deer from Scotland are smaller than those found elsewhere (Red Deer Commission 1981, 10; Clutton-Brock et al. 1982, 11) which is a reflection of the harsher environment in which they live. This is phenotypic variation, rather than genotypic; when young stock are taken from Scottish hills and reared in less severe environments they grow as large as continental red deer (Red Deer Commission 1981, 10; Clutton-Brock et al. 1982, 11). Stags from Scottish hill populations reared in parks, plantations or farms can be up to twice the weight of those remaining on the hills (Callandar and MacKenzie 1991, 54). The Scottish environment is hostile because vegetation species are limited and the soils poor in requisite minerals (Clutton-Brock et al. 1982, 11) and also because the weather conditions mean that the animals must expend considerable amounts of energy maintaining body temperature (Red Deer Commission 1981, 24).

Deer belong to the group of mammals known as ruminants that comprise two families: horn-bearing *Bovidae* (cattle, antelope, sheep, and goats) and antler-bearing *Cervidae* (deer). Ruminants have a four-chambered stomach, the first part of which is a sac containing microbes. These microbes produce an enzyme, which breaks down the otherwise indigestible cellulose, the material from which plant cell walls are made. After soaking in this sac, the material is returned to the mouth for further mastication, a process known as ruminating, or chewing the cud. Other herbivorous animals overcome the indigestibility of vegetable matter in other ways. Some, such as mice, restrict their intake to seeds, nuts and new growth; some, like horses, settle for a less efficient digestion and the accompanying greater throughput of material; and others, for example, rabbits, reingest their faecal pellets (Red Deer Commission 1981, 16). The ruminants' digestive tract can be seen as 'an evolutionary peak in digestive efficiency' (Red Deer Commission 1981, 16) and enables them to subsist, when necessary, on poorer quality vegetation than other herbivores can (Geist 1971, 9). They are therefore ideally suited to living on the relatively sparse and often woody vegetation of the Scottish hill slopes, with abundant grasses, sedges and herbs of summertime allowing the animals to build up fat reserves. They are then dependent on browse, from trees and shrubs, including heather, for survival in winter (RDC 1981, 17; Darling 1937, 149). McCormick (forth. 6) argues that the exploitation of red deer in the Western Isles allowed people to convert more vegetation into meat, than would be possible with only cattle and sheep. This is because the deer can graze higher altitude hill land than the hill sheep can, so more efficient use of the land is made, despite deer needing more energy per unit of body weight than do sheep.

The social behaviour of red deer varies according to season, diurnal rhythm and the age and sex of the animals. Generally, they are a social species, exhibiting herding behaviour. Herd size and the relative numbers of stags, hinds and young in it will vary throughout the year. A great deal of research has been conducted on the social behaviour of red deer (e.g. Darling 1937, Red Deer Commission 1981; Clutton-Brock et al. 1982). Social behaviour, and diurnal and annual movement of the herd, reflects the deer's need to maximise access to food and the security gained from being part of a group of animals. Groups of stags and hinds (the latter of which include 'followers', calves and immature animals of both sexes) live separately for most of the year (Darling 1937, Red Deer Commission 1981, Clutton-Brock et al. 1982). Stags older than three years tended not to be present in the hinds' groups. The rutting season is the main time in which males and females group together, when dominant males herd hinds into groups which the stags then expend much energy protecting from the attentions of rivals. The size of herds in which the hinds gather varies diurnally as well as annually, with group size ranging from two individuals to over eighty. Stags gather in looser groups, and, unlike hinds, their grouping behaviour seems to be more influenced by territory, and the age of the individual than it is by relationship to other party members (Clutton-Brock et al. 1982, 191). Stags of similar age tend to associate together, with younger animals being more peripheral to the group than older ones. The reason for this sexual segregation may be due to differences in dietary requirements between the sexes (Clutton-Brock et al. 1982, 194) as nutritional need varies according to season as well as with the age of the individual. Diurnal patterns of movement among deer seem to be influenced by predator activity (humans are the main predator), on the open hill the deer prefer to be on higher ground in the daytime, using lower ground at night. The aggressiveness of the stags at the time of the rut is often cited as a deterrent towards their domestication but deer can live successfully in an enclosed space if it is large enough. Various species of deer have been maintained in parks and royal forests for hunting purposes, since medieval times. Supplementary feeding and provision of salt licks for such herds accustoms them to humans and qualifies them for a semi-domesticated status; the animals can be selectively culled for meat and to maintain viable flock sizes, but the herd is otherwise not interfered with (Clutton-Brock 1999, 205). While it can be argued that it is hundreds of years of royal protection that led to this rare coexistence of human and large mammal (ibid. 205) it can also be envisaged that an island might provide a similar environment in which the herds could be contained. Similarly a peninsula would seem to provide a natural enclosure in which deer could be encouraged to live, or, at other times of the year, could be excluded from.

An example of an animal in Britain today with an unusual domestic status is the North Ronaldsay sheep. The small, slender built, often dark coloured sheep live on the island of North Ronaldsay, in Orkney, and are restricted to the foreshore and beach of the island by a drystone wall (dyke) built around the coastline. These animals cannot be regarded as wild or feral, as they are owned by humans with whom they have some contact, being rounded up on three occasions in a year (an activity known as "pundin") for shearing, scoring (marking and counting) and for selection for killing (Fenton 1997, 464 – 9). The sheep otherwise receive no attention, even when lambing. People do not control their breeding, organisation of territory or food supply. The sheep survive on seaweed, grazing from weed exposed at the low ebb in summer and on the large quantities thrown ashore during storms in winter. Consequently, they are in their best condition at Christmas and New Year, which is generally when they are killed for meat. The ease with which the zooarchaeologist can collect sheep bones during a walk along the shoreline testifies to the harshness of the environment as well as to the different taphonomy of the remains of animals living in this way. The North Ronaldsay sheep provide an example of an ancient form of communal farming; all the sheep owners assist in the "pundin" and also in the maintenance of the 5 to 6 foot high sheep dyke that extends all round the 12 mile perimeter of the island (Fenton 1997, 466). The dyke is a surviving example of type of land boundary known elsewhere in Orkney as a hill-dyke, a long structure built of either stone, or turf. During the seventeenth and eighteenth centuries in Orkney, the land was otherwise unenclosed and the hill-dyke was important for keeping animals away from arable land and for delineating land of different parishes or townships (Thomson 2001, 322). The hill-dyke was largely turf, so could be opened up after harvest to let the animals graze the corn stubble fields and to wander over the in-bye land (near the crofts) during the winter (ibid.).

Speculatively then, perhaps the peninsular nature of Bhaltos allowed a barrier of some sort to be constructed to restrict the red deer to the peninsula itself. Either this could have been done all year round or only in the winter when shortage of fodder on higher land would drive them down nearer the shore anyway and when there were no crops to damage. Red deer are more difficult to contain within fences than sheep and cattle because of their ability to jump considerable heights. Of course, archaeological confirmation or refutation of such a barrier would be difficult to acquire, particularly if it was built from turf. Any such barrier would very likely have been reinforced by other means to protect the crops. In seventeenth century Orkney the dykes were maintained or rebuilt each spring so the domestic animals could be kept on the hill land and away from the arable land. Children and dogs also assisted in keeping animals off grazing land (Thomson 2001, 323). It is unfortunate that information on season of death could not be obtained from the red deer assemblage as it might confirm or refute this hypothesis by indicating a seasonal bias in red deer deaths. For example, a predominance of winter deaths might suggest the deer were being killed when down off the higher hill land and grazing on land more accessible to the sites' inhabitants.

It is necessary to consider what archaeological evidence might be acceptable as support for the management or farming of red deer, rather than the hunting of a natural or managed resource. The farming of red deer might be expected to produce evidence of some neonatal deaths in the archaeological record, as is the case with domesticated animals generally. Possibly a system where the animals were domesticated would result in primarily young and prime animals in the assemblage there being little point in maintaining animals beyond peak, meat producing maturity, except for a few breeding animals.

Conversely, a hunting strategy might result in animals that were more diverse in age when killed, with the older, frailer ones, and younger, inexperienced individuals possibly being more easily brought down than the prime animals. An animal management system would be more difficult to detect as it might lie anywhere between the two extremes. The culling of animals from managed (and by implication easily caught) herds might be expected to select a certain type of animal, perhaps of a preferred size, age or sex. While deer are considered as marauding pests when they encroach on crops today, they might have been welcomed in the past when they were regarded as a valued and accessible source of food. The lure of growing crops might have encouraged the animals nearer settlements and thus made them more easily killed. It could also be argued that the deer are more likely to be grazing higher up on the hills during the summer when the crops are in the fields. However, the author has seen young red deer stags in gardens in the early morning of the 4th of May 1997, at the famously remote village of Inverie on the Knoydart peninsula in north west Scotland (so the animals were still at a low altitude well into the spring). The area has been proposed for the re-introduction of wolves to Scotland, reflecting the overpopulation crisis that doubtless explains the appearance of the animals in the gardens so late in the year. Young groups of stags together have been seen to be braver, or more foolhardy, than groups of the more cautious hinds (Darling 1937) and this might explain the behaviour of these animals at Inverie.

If red deer were present on the island of Great Bernera, which lies close enough to Lewis for them to reach by swimming, it seems possible that arrangements to entice them close to the settlement and trap them with minimal hunting effort could be made. There is zooarchaeological evidence for all skeletal elements being present in the assemblage from Bostadh, or at least, there is no indication of persistent under-representation of any low meat bearing elements. Thus, it can be hypothesised that complete carcasses were present on site, and further, that every part of the body is completely consumed, with little wastage. Hence, there is no evidence that the red deer was regarded as a high status animal, used for feasting and special occasions, where more wastage might be expected.

At Beirgh, the situation is different, as the settlement was separated from arable land by the loch that surrounds it. Obtaining animals would therefore have involved a special trip and all animals, however procured, would have had to have been carried across the causeway, or by boat, to the settlement. The element distribution analysis does not suggest that complete red deer were taken onto site at Beirgh however; instead, joints of meat were being imported. Jointed sections of carcass would be lighter and more manageable to transport to the island than entire carcasses.

An alternative explanation could be that the animal was regarded as a high status food, used for feasting only, and the feet, heads and other parts were disposed of elsewhere, presumably off the island as they have not been retrieved during excavation.

6.1.2 Hill sheep in Atlantic Scotland

A little has been said about the distinctive living arrangements of the North Ronaldsay sheep (6.1.1) and the management system that confines them to the foreshore to exist mainly on seaweed. Other breeds of sheep, indeed other ruminants, also browse on seaweed. The author had occasion to spend several weeks, alone, in late winter and early spring overlooking part of the Shetland shoreline from 9am to 5pm, six days a week, while carrying out wet-sieving as part of an excavation team. Sheep were noticed on a daily basis browsing exposed seaweed on the rocky foreshore at low tide. They routinely included the foreshore in their daily foraging walks. The author has also observed cattle grazing on the beach at North Uist, and, albeit on television, has seen red deer eating seaweed in the Western Highlands. The use of marine plants in the diets of these animals has potential implications for the reliability of radiocarbon dating bones from such supposedly terrestrial species in that the marine reservoir effect, caused by recycling of "old" carbon in the seas, might produce an inaccurate date. For this reason single entity AMS dates from single cereal caryopses (obtained from sample processing) are preferred in the Atlantic region where possible (Church 2002, 54).

Hill sheep, still common in the Highlands and Islands of Scotland, although indisputably domesticates generally live in unenclosed landscapes and travel around them to feed. They are known as hefted sheep and have different behavioural instincts from those of Lowland sheep, including a tendency to disperse, rather than to flock, at times of perceived danger, and a strong homing instinct (Ryder 1983, 710). It is believed that the lambs learn from their mothers about the territory and the food available to them. After the widespread slaughter of flocks of sheep in upland Cumbria following the foot and mouth epidemic of 2001 there was concern about the threat to the hefted sheep that roam the uplands. The concern was that new flocks, introduced after the disease was eradicated, would have to be shepherded around as they would be unfamiliar with the area and the locations of the best food (e.g. Rose 2001). A news report from November 2001 revealed that this was indeed the case; the new sheep were making too much use of village space and needed to be trained by "ship badgerers" to avoid village gardens and other sensitive property (BBC News Online 2001). There are considerable archaeological implications of this method of controlling livestock, including the fact that neonatal bones are unlikely to appear on site if sheep are lambing by themselves at some place distant from the site. Dead lambs are commonplace in the intensive farming situations we are familiar with today, but probably were less so in the past. The traditional breeds of sheep, not being bred for colossal size, give birth more easily than do modern breeds, and are more likely to do so at a place of their own choosing. The death of a lamb in a remote spot would not show on the archaeological record, so any neonatal and young bones in the assemblage would be more likely to represent a deliberate killing, perhaps for the skin, or for meat if quantity and economic efficiency were not considerations.

It is important that knowledge of animals and animal husbandry is applied when considering animals in prehistory. Understanding the ecology and behaviour of the species that have had a long association with humans is useful when trying to interpret archaeological evidence. A good example of the use of modern knowledge of sheep husbandry helping in the interpretation of archaeological evidence is provided at Fengate where a complex field boundary system was found to be a "race", a device for separating sheep from the flock for inspection (Pryor 1998, 96 – 105).

6.1.3 Cattle in Atlantic Scotland

Not being totally adapted to the climate of Scotland, cattle normally have to be protected from winter weather by being housed. They require supplementary feeding, certainly throughout the winter and sometimes at other times of the year. In the north Atlantic region they face particular problems. There is documentary evidence, from the eighteenth and early nineteenth centuries, of cattle being so weak by the springtime they had to be carried out to the pasture from the byre (McCormick 1998, 50). There is historical evidence of cattle being fed seaweed, potatoes, heather, cabbage and even boiled fish when hay and straw were in short supply during the eighteenth century (Fenton 1997, 428).

There are two reasons to be sceptical about such evidence however. Firstly, the eighteenth and nineteenth centuries were a time of huge changes in agriculture in Britain, with the agricultural improvement movement in the lowland areas and the beginnings of crofting in the Highlands (Willis 1991, 32). Both were developed with the aim of ending the communal farming system of run-rig, and both aimed to improve the productivity of the land. The situation in the Highlands, including Lewis, was complicated by the coming of *Na Caoraich Mhor* (the great sheep, i.e. the Cheviot) to the land, as a response to the great demand and concomitant high prices for wool (Willis 1991, 32; Prebble 1963). The implementation of such change, generally deleterious to most of the local human population, obviously required considerable political back-up (or "spin" in today's terminology) and many books were produced to this effect (e.g. Shirreff 1814; Statistical Account 1792 – 1799). It can be argued that many of the sources quoted by McCormick (1992; 1998) are likely to reflect such political initiatives.

The second reason to doubt McCormick's historical sources is that, even if they are true, even if cattle were practically starving to death over the winter for lack of fodder in the eighteenth century, the situation need not have been the same in the Late Iron Age. The 18th Century may have reflected a climatic nadir, a particular stress on the land's resources caused by population pressure, or any number of other situations. Historical and ethnographical sources should not be extrapolated back to prehistory and used to interpret mortality profiles (McCormick 1992) nor uncritically accepted as evidence for the shortage of fodder, or for the perceived marginality of the islands. Such historical accounts may well have been devised to illustrate the unsuitability of the environment for cattle, and the people who depended on them, and by implication to prepare the way for the Cheviot sheep.

Cattle comprise a large proportion of the archaeological assemblages retrieved from Late Iron Age sites in Atlantic Scotland (e.g. see chapters 4 and 5 above; Cook 1997b; McCormick forth.; Smith et al. 1994; Mulville 1999). It seems reasonable to assume they were of considerable economic importance and that sufficient resources were usually available to maintain a herd.

6.1.4 Birds in the coastal environment

Most of the bird bones retrieved from the assemblage at Bostadh and Beirgh were from species found on the "sea cliffs and rocky islands" (Fitter 1973, 247). The only exceptions are Brent goose and herring gull, classified by Fitter as belonging to "seashore" (ibid. 241) and "salt-marsh and estuary" (ibid. 219) respectively.

Shearwaters and puffins dig burrows in sand or turf, or they may reuse rabbit burrows (Fitter 1973, 249, 259). Small auks, such as the black guillemot and the razorbill nest in crevices and cavities within heaps of boulders (Everett 1983). Gannets nest on the ground on cliff tops and remote islands (Everett 1983). Herring gulls nest on the "ground, cliff ledge or building" (Fitter 1973, 241). Both herring gulls and gannets nest in large colonies. The birds that nest in cavities between and underneath boulders might nest in abandoned buildings. Drystone walls could provide an environment similar to either a cliff ledge or a cavity within boulders. The burrowing birds might use the sand layers within the abandoned buildings to nest in. Of the species retrieved only the guillemot would not be likely to nest on or around the site, as it favours cliff ledges for nesting, but again, similar ledges might be envisaged within an abandoned building. Hence, any of the species might represent intrusive bones; birds that died while nesting or raising their young. Birds might have used the site for nesting at any time after its abandonment.

Due to their nesting habits any of these species would have been easily caught if desired as a food item, so the possibility that they formed part of the diet cannot be ruled out. Birds are vulnerable to capture when they return to the nest, indeed some of the species retrieved from Bostadh, such as gannet, shearwaters and the auks, only come onto land to breed, living out at sea for the rest of the year (Serjeantson 1998). They provide a valuable dietary supplement in the late spring and early summer when little other food may be available. The eggs of ground nesting birds would likewise provide a valuable food resource, though archaeological evidence for egg consumption is rare, particularly in a free-draining, stony environment such as Bostadh. There is ample historical and ethnographic evidence of harvesting birds and eggs from sea cliffs, most notably from St Kilda (e.g. Fenton 1999, 184 – 185; Fenton 1997, 510 – 523; Seton 1980, 193 - 200).

6.2 Beirgh and Bostadh in the context of Atlantic Scotland

It is proposed now to consider the results of the mammal bone analyses from Bostadh and Beirgh together to compare the two sites. The results will then be compared to those obtained by other workers from other excavations on the Bhaltos peninsula in West Lewis. The excavations are from the wheelhouse at Cnip (McCormick, forth.) and from the Late Iron Age occupation levels at Beirgh. The fact that animal bone workers differ in their methodologies presents difficulties when attempting to compare the results obtained by different workers. For this reason only the conclusions reached will be compared to the results obtained in this thesis.

6.2.1 Comparison between Bostadh and Beirgh

The analytical results from the two sites will be discussed, concentrating first on the large, commonly represented mammals, then the smaller and rarer taxa.

6.2.1.1 The large mammals

Cattle appear to be the most abundantly represented species in the mammal bone assemblage, when quantified by weight or by NISP, throughout all four occupation phases at Bostadh. They appear to become proportionately less well represented through Phases 3 and 4 but this is probably due to the increasing representation of red deer in those assemblages. A quantification method devised to reduce the inter-dependence of each species on both of the other species, the homologous elements method (Bond and O'Connor 1999, 338), produces contrasting results (see Figure 5.4). Calculating the relative proportions of species according to the relative proportions of a set of homologous elements (HE) chosen for their similar tendencies to resist taphonomic processes demonstrates that sheep/goat are proportionately the most abundant animal on site during all four occupation phases. The relative proportions of cattle in all four phases remains remarkably consistent when using this method of quantification, varying from 30% in Phase 1 through 31% during Phases 2 and 3 and 32% in Phase 4. At Beirgh the cattle dominate the assemblage regardless of the quantification method used (Figures 5.1 and 5.4) and, again, the usefulness of the homologous elements quantification method is demonstrated. Counting the set of eight homologous elements (Bond and O'Connor 1999, 338) reduces the over-representation of the bones of larger species caused by their tendency to fragment into more identifiable parts than do the bones of smaller species. This increased fragmentation of larger bones results in them being relatively over-represented in NISP calculations. The HE figures for the Beirgh assemblage (Figure 5.4a) demonstrates that cattle comprise about half of the assemblage, a greater proportion than in any of the Bostadh assemblages. This may be a factor of retrieval techniques used, or may indicate proportionately higher representation of cattle at Beirgh than at Bostadh. If this higher representation in the retrieved assemblage is reflected in the death assemblage, then it might suggest cattle were relatively more important at Beirgh than at Bostadh.

As cattle are large animals, expensive to feed, and taking longer than sheep to mature, their relative abundance could be interpreted as suggesting that the people at Beirgh, during Phase 5 may have been wealthier than the inhabitants of Bostadh ever were. The slaughtering of any animal creates a large amount of meat, and prior to the recent development of refrigeration, must have involved some sort of preservation of the surplus. It also probably involved sharing, certainly among the people on site, and quite probably with people outside the site. It is easy to imagine a community gathering together to disperse the meat from a carcass in order to consume it while still fresh, then next time killing an animal from another site. This would save the laborious and risky (in terms of hygiene) task of preserving meat and keeping it free from vermin. Methods of meat preservation would have been available, both smoking and salting could have been done. Indeed the building style of the structures at Bostadh would have been extremely conducive to smoking meat and fish. The buildings had a central fire and are believed to have had no chimney vent. In the reconstructed building (Neighbour and Crawford 2001) the smoke disappears by filtering through the thatched roof.

Blackhouses were still occupied in parts of Lewis until the early 20th Century, and at a township in west Lewis called Arnol, until the 1960's (Shaw Grant 1987, 97; Fenton 1995, 33). A blackhouse is a long, low croft house incorporating a byre for cattle at one end, and two rooms for human use. The rooms both had fires, usually in the centre of the room. They had a central hearth and allowed smoke dispersal through the roof. Blackhouses were common throughout the Highlands and Islands of Scotland and can be easily spotted in ruinous condition scattered over the landscape. Their origin is unknown to the author but they may have originated as a modified version of the Norse Longhouse. The Arnol blackhouse is now under state guardianship and can be visited and the smoke experienced. While such exposure to the smoke from wood or coal would be intolerable, the peat smoke is not unpleasant and may even have health benefits as it has an antiseptic effect. It certainly provides a respite from insects such as midges, and probably also deterred fleas and other parasites. Peat is an abundant resource in Lewis as elsewhere in Atlantic Scotland, and would have been easily extracted using technology available in the Iron Age. So while it would have been possible to preserve meat by suspending it from the roof rafters, the smaller animals and the smaller cuts of animals, would presumably have been preferred for this process, their greater surface area to volume ratio making them cure faster. Killing of larger animals would have required the meat to have been divided between several households, to have been consumed in a large feasting event. The intention here is not to infer greater status at Beirgh than Bostadh purely from the comparatively larger proportion of the assemblage made up of cattle. Instead it is suggested that, if the different proportions of animals at the two sites in the recovered assemblages indicate a real difference in the death assemblage, then that difference may be due to greater economic wealth, or stronger social connections with neighbours.

Red deer appear to be proportionately more abundant at Beirgh than they are at any phase at Bostadh, (from Figure 5.4). The homologous element representation method supports the hypothesis that red deer become more important during Phases 3 and 4 at Bostadh. In fact the relative proportions of deer in the assemblages from Phase 3 and 4 are very similar when calculated by HE, or by (adjusted) NISP or (adjusted) weight (Figures 5.4, 4.3, 4.4). The element representation for red deer at Beirgh suggested importation of shoulder joints as the scapula and humerus are relatively over-represented compared to the other elements. This might indicate trading or exchange of meat with people outside the site. Over representation of high meat-bearing elements might also indicate hunting and dismembering of the animals at some place distant from the site. Such an explanation would not explain why corresponding elements from the hindquarter, the pelvis and femur, were not also highly represented (Figure 5.5). The femur and pelvis are slightly less well represented than would be expected if all elements were present in equal quantities and it seems unlikely that this indicates a retrieval bias or another taphonomic factor, since they are structurally similar in size and shape to the over-represented scapula and humerus. At Bostadh the situation with the red deer element and body part representation is different, with roughly equal limb representation for the first three phases then a predominance of hind limbs in Phase 4, the Norse phase. The assemblage examined from Beirgh came from Phase 5, one of the Cellular phases, and is believed to date from the middle of the first millennium AD (Harding and Gilmour 2000, 62; Church 2002, 66). The Norse occupation phase (Phase 4) at Bostadh is believed to date from the end of that millennium (Neighbour pers. comm., Church 2002, 66) so it cannot be suggested that the limb representation evidence suggests trading of red deer body parts between the sites.

Body part representation data for cattle at Bostadh indicates something different may be happening during Phase 3 when hindquarters are more numerous than forequarters and low meat yielding bones more abundant than high meat-bearing elements. Faunal evidence from floor deposits in House 1 suggest butchery activity taking place during this putative "squatter" phase which is believed to have seen the transition from indigenous people to Norse occupation of the site. "Structure M" is an arc of orthostats and a floor level believed to post date the original abandonment of House 1 (Neighbour 2001, 20), may be related to butchering or other food processing activity. That would perhaps explain the temporary nature of the structure (which leads to it being termed a "squatter" phase); the need for a hearth; and the disposal of bones in closer proximity than might be tolerated for living accommodation. Since it is not known whether the entire occupation area at Bostadh has been detected and excavated the people using House 1 at this time may have lived nearby.

The body part representation for sheep/goat from both sites suggests they were present as complete carcasses, as might be expected in a smaller animal that would provide a manageable quantity of meat.

The age at death analysis

Generally there does not seem to be a high death rate of neonates of any of the three most abundant taxa at either site. While this may reflect high standards of husbandry and sufficient fodder to maintain successful breeding stock there are alternative explanations. The presence of mature pig at both sites suggests that bone from young and neonatal animals is not surviving, as pigs are generally assumed to be kept as meat animals only. Prolific breeders and omnivorous consumers of household waste, pigs are ideal animals for meat production and their general relative scarcity in the archaeological record, particularly in Scotland is puzzling, and can probably be attributed to the young age at which the piglets may be killed, together with the possibility that more of their bones are cooked. Both would influence the preservation of the bones. In cases like Bostadh and Beirgh where mature pigs are present it seems even more likely that this is the case. Whatever taphonomic processes are acting to prevent the appearance of young pigs in the retrieved assemblage are likely to affect the preservation of neonatal bones also.

There is evidence of all taxa surviving to maturity, so it is likely they were bred on or near both sites. Red deer appear to be living to a greater age than are the other ruminants. This may reflect a different procurement technique, hunted animals rather than domesticates. Hunting deer would probably require horses and dogs, which are scarce in the assemblages at Bostadh and Beirgh, possibly because they are unlikely to be deposited in middens along with kitchen or butchery waste.

Taphonomic indicators

Analysis of the taphonomic indicators on the bones suggests the preservation conditions are generally good at both sites and for all species and elements. A more detailed study of preservation was carried out on the larger assemblage retrieved from Beirgh and showed that teeth, mandibles and distal phalanges (hooves) were best preserved (Table 5.20). These bones obviously need to be strong and durable in life, since they are the bones undergoing most of the impacting contact with external objects. These bones are not covered in much, if any body tissue to offer any protection, so are dense and solid and as such likely to preserve well. Size does not appear to influence the state of preservation of bones as the worst preserved bones, like the best preserved ones, were small bones. The astragalus and the proximal phalanges had greater proportions of poorly preserved bones than the average percentage figures for all elements together, possibly reflecting their distinctive shapes. For instance, an astragalus in preservation state "d" would perhaps have more chance of being identified as such than, say, a fragment of femur. Similarly the proximal phalanx and the astragalus are dense and compact bones so likely to survive in an identifiable condition longer than other, larger bones that might have fragmented to an unrecognisable state by the time their surfaces reached states "c" or "d" (less than and greater than 50% of the bone surface missing, respectively).

Very few bones were stained or gnawed. Larger elements from larger taxa appeared to display slightly more gnawing marks than did smaller bones, probably indicating that the larger bones survived carnivore attention better than did the smaller ones.

Butchery marks were present on between 10 - 20% of the bones from the two sites. In the case of the Beirgh assemblage the butchery marks were analysed for each taxon individually and are discussed fully in 5.5.4. Such extensive analysis of the butchered remains at Bostadh was not carried out because of the small assemblage size and because a smaller percentage of fragments displayed butchery marks. Butchered seal bones, found at Beirgh, may be of interest since seal teeth have been discovered and interpreted as special deposits, in a context dating to a later occupation phase (Phase 4) at Beirgh (D.W. Harding pers. comm.). One butchered bone fragment from horse was retrieved from Beirgh, from a small sample of five horse bones retrieved from site. There is no reason to rule out human consumption of horsemeat, but equally no reason to deduce from one bone that it was a common occurrence.

6.2.1.4 Other animals

Among the less well represented animals present in the assemblage were otters which were present at both sites, although only four fragments were retrieved from Beirgh. These four fragments of otter bone were a complete calcaneum, a fragment of humerus shaft and two fragments of ulna. The bones represent at least two animals, displayed no cut marks and were retrieved from four different contexts. As it is likely that otters lived in the site after it was abandoned these bones probably represent intrusive bones.

At Bostadh the situation is similar, but more otter bones were retrieved, probably because of the sieving programme. Some of the otter bones retrieved from Phase 4, the Norse occupation phase, displayed knife marks indicating they had been skinned. One pine marten mandible was also retrieved from the Norse phase and probably represents an import, attached to a pelt.

Ten grey seal bones were retrieved from Bostadh and only one, a vertebra from the neck (axis) displayed any butchery marks. The other bones might represent natural beach finds incorporated into wall cores. Fourteen bone fragments from seals were retrieved from the assemblage at Beirgh of which six displayed butchery marks. Both common seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) were present among the butchered bones. The bones that were butchered were a mandible, ulna and radius from grey seal and two femurs and a scapula from a common seal. The grey seal butchered bones had no ageing information on them at all, while the common seal femurs were both fusing at the proximal end and one was fusing at the distal end (the distal end of the second was missing). It can be assumed that these bones come from animals that have just reached their adult size. The butchery marks on the grey seal mandible were right at the front of the jaw and might represent the removal of incisor or canine teeth. Alternatively the marks might be from skinning, if the skin of the head was retained on the main pelt. The butchered ulna and radius were cut where the two bones join, about midway down the shafts. The limb bones in the seal are much shorter than in the ungulates (for which Dobney and Rielly's zones were designed). Therefore, cuts on Zone 7, of the radius, and Zones E and F in the ulna, are closer to the end of the foreshortened bones than they appear on the ungulate bones (Dobney and Rielly 1988, 87). The butchery marks may well represent skinning of the animals, in the process of which the skin from the limb bones would be removed. The situation is similar for the common seal bones. The two femora have knife marks on Zone 8, near the distal end, which might indicate removal of the lower limb and retention of only the skin over the (foreshortened) femur. Likewise, the scapula has cut marks near the articulation with the humerus, possibly indicating removal of the limb during skinning. Although all the seal butchery marks could have resulted from skinning, the meat may have been eaten as well. The small number of bones present in the assemblage (14) indicates that seals were not an important dietary item. Of the remaining eight unbutchered seal bones one distal humerus fragment was unfused and one radius had both ends unfused. If it can be assumed that seal epiphyses fuse in the same order as do those of the other mammals then the unfused distal humerus and proximal radius suggest young animals. Young seals are vulnerable to being caught shortly after birth and during their first moult. The only other ageing information on the unbutchered seal bones is on two scapulae, which are fused. Again, if it is assumed that the scapula fuses early in life as it does in other mammals, the fusion information does not reveal much about the age of the animals. None of the seal bones retrieved were identified as "neonates". However, seals are larger, compared to the adult size, when born and grow more quickly, than land mammals of comparable size. As seals more than double their weight in the first three months of life (Lockley 1966), neonatal bones might not be as obvious as in land mammals, generally smaller and more helpless after birth than are seals. Alternatively the taphonomic processes destroying other neonatal bones might be affecting those of seals also.

Goat does not appear to have been discovered in the Late Iron Age in Lewis before now, although the research (Serjeantson 1990) was carried out before much of the recent work in the Outer Hebrides was completed. Goat was not found at Dun Vulan (Mulville 1999, 236), or at Rosinish (Serjeantson nd, 7). (Rosinish is a site on Benbecula believed to date to Bronze Age and Neolithic times (Armit 1996, 92), although the dating may be unreliable, based as it was on marine shell. The date and nature of the site is not important in any case, but it is an example of a Hebridean site for which faunal analysis has been carried out).

If the bones retrieved from Beirgh and Bostadh are goat, rather than sheep, then their discovery is of interest. However, a second opinion on the identifications must be sought, before any definite statements are made. The difference between sheep and goats is of little consequence in any case, particularly when talking about prehistoric sheep that probably resembled the modern Shetland, Soay or North Ronaldsay breeds. All are slender built; varied in colour; nimble and fast; and with somewhat coarser, hairier wool than other modern breeds. Hence, they resemble goats more than they resemble modern large sheep such as Cheviots or Suffolks. In addition, both sheep and goats can be used for milking, for meat, for wool / hair and for skins. To an extent the difference between them is negligible and the often-derided zooarchaeological convention of categorising them all together as sheep/goat is justified.

6.2.2 Animal bone from Late Iron Age Beirgh

Three bone assemblages from Late Iron Age, or "Pictish" levels at Beirgh have been examined (Cook, 1997b) and will be discussed briefly here as comparanda for the Beirgh and Bostadh assemblages. The material analysed derived from the figure of eight occupation phases, dated to the 7^{th} to 9^{th} centuries AD by artefact typology (Church 2002). This makes them broadly contemporaneous with the figure of eight buildings at Bostadh, as far as the limitations in the ^{14}C dating will allow.

6.2.2.1 Structural chronology of the Late Iron Age occupation phases at Beirgh

Three assemblages were analysed, from the layers above the cellular occupation phase that the bones discussed in Chapter 5 derived from. The later structural phases comprised two figure-of-eight structures built within the walls of the complex Atlantic roundhouse. Structure 2 is the earlier figure-of-eight building, part of which was reused in construction of Structure 1, the later figure of eight building.

The two structural phases were broken up into six sub-phases for analysis, with sub-phases 0, 1 and 3 representing occupation surfaces, including floors. Sub-phase 0 contained only four bone fragments that were identified to species, so has been removed from the analysis. Sub-phase 1 consists of contexts derived from the floor layer and associated occupation deposits of Structure 1 and contained 134 identifiable bones, permitting some speculative comment on the mammal remains. The bones from Sub-phases 1a and 2 were combined to give an assemblage of 1952 identifiable specimens. Sub-phases 1a and 2 are believed to represent redeposited midden material (Cook 1997b, 14) derived from Structure 2.

Sub-phase 3 produced only twenty one specimens identified to both element and species and is the wall-fill and occupation deposits from Structure 2

Sub-phase 3a is midden material dumped in the northern cell of Structure 2 and is believed to represent "deliberate deposition of occupation refuses" (Cook 1997b, 14) during the latter stages of the occupation of Structure 2. 156 identifiable specimens derived from this sub-phase.

Because the methods of analysis employed in the study of the bone from these later occupation phases at Beirgh were very different from those employed by the author only the conclusions reached by Cook (1997b) will be discussed here. They will be compared with the results obtained at Bostadh and at the earlier occupation phase (Phase 5) at Beirgh. For the same reason no attempt will be made to re-interpret the data provided by Cook (1997b) or to directly compare them to those data presented in Chapters 4 and 5.

6.2.2.2 The results from Sub-phase 1

Sub-phase 1a produced 134 identifiable bones which is too small a sample to reveal much about the economy of the site. Bone fragments from red deer and cattle are present in roughly equal quantities (45 and 49 respectively) when quantified by NISP. Cook also quantifies the various species in terms of MNI (2 and 4 respectively). He then uses the MNI figures to calculate body weight and meat weight and % meat weight for five species, cattle, red deer, sheep, pig and horse. The figure for % meat weight is calculated from the meat weight of any one species as a percentage of the summed meat weight from all species. As the current writer has little faith in MNI as a quantification method, and as it is unrealistic to perform statistics on numbers that represent minima, these various approaches to quantifying animal remains will not be returned to.

Red deer differ from cattle and sheep in the body part representation in this phase, with a wider range of elements represented, including high meat-bearing bones. Cattle and sheep remains are predominantly small, dense and low meat yielding bones, mainly teeth. Red deer teeth are also the most abundant skeletal element present, but less numerous than for sheep and cattle (Cook 1997b, 24). However, as the element representation figures are presented as percentages (of elements retrieved) then the problem of interdependence occurs. The presence of "a wider range of bones" (Cook 1997b, 24) from red deer will reduce the percentage of teeth. Thus the conclusion reached that the perceived lack of red deer teeth might be due to their greater fragility or to differential processing of red deer heads connected with antler working can be rejected. The second conclusion reached by Cook (1997b, 28) is that the results from the analysis of the bones from Sub-phase 1a indicate red deer are being treated differently from cattle and sheep on the site which supports the conclusions reached in this study.

6.2.2.3 The results from Sub-phase 1a and 2

A larger sample of identifiable bone fragments (1952) was obtained from these sub-phases, which are believed to represent material derived from redeposited earlier structures and middens. Red deer and cattle are the most abundant species (NISP of 725 and 650 respectively). The NISP figures for Phase 5 are 609 and 906 for deer and cattle respectively (Figure 5.2). The MNI figures from sub-phases 1a and 2 are 34 and 19, but unfortunately the elements on which the figures are calculated are not given. The MNI figures are startlingly similar to those obtained in Phase 5, of 34 and 20 for red deer and cattle (Table 5.2). As different methods of MNI calculation were used this is presumably a coincidence.

For the body part representation results Cook found higher proportions of high meat bearing bones for red deer than for sheep and cattle, but again this might be due to the use of percentages. It is not clear whether Cook (1997b, 41) believes high or low meat-bearing bones predominate the assemblage of red deer bones and he proposes two contrasting hypotheses on how the carcasses arrived on site according to whether it is felt high or low meat bearing bones are dominant in the assemblage. The reason for the confusion lies partly in the over-use of the word "dominance", which is used in connection with low meat-bearing bones when discussing the element representation of red deer bones, to argue that near complete carcasses are imported onto site. Cook (1997b, 41) then argues that the predominance of high meat-bearing bones in red deer, presumably meaning relative to those present in cattle and sheep, indicate red deer were being processed differently to cattle and sheep and suggests they arrived on site in a "semi-butchered" state (Cook 1997b, 41). The conclusion is reached (ibid. 43) that deer were obtained by communal hunting and that the carcasses may have been divided among the hunters.

The elements that are over-represented among the cattle assemblage are the teeth, the proximal phalanx, the calcaneum and the astragalus (Cook 1997, 32, Figure 14). The proximal metacarpal is also present in slightly greater amounts than would be expected if the elements were distributed in the same proportions as they occur in the body. All the aforementioned bones are structurally compact and dense and probably represent bones that have survived heavy taphonomic losses. The four elements also have a distinctive shape, and density, which might lead to them being more recognisable in the trench, to both eye and trowel, than other specimens of similar size. They are also readily identifiable to species on the analyst's bench, which might explain also their relative over-representation.

In the case of sheep the bones that are over-represented in the assemblage are teeth, scapula, distal humerus, proximal radius, proximal ulna, distal tibia, calcaneum and astragalus (Cook 1997b, 35, Figure 17). These are all dense bones likely to survive taphonomic losses.

The red deer element representation indicates that the teeth are slightly over-represented. In cattle and sheep they have been greatly more abundant (> 8% more) than the "expected" percentage figure given. The elements that are over-represented in the red deer assemblage from Sub-phases 1a and 2 are the distal tibia, calcaneum and the astragalus. The elements of the forequarter, the scapula, humerus, radius and ulna are well represented, being 2 – 4% more abundant than in the skeleton. The phalanges are less abundant in the assemblage than in the skeleton which might imply they are removed elsewhere (e.g. at the scene of the kill) but is more likely to reflect the lack of sieving during excavation. While these results support the hypothesis that joints of meat, rather than whole carcasses were brought onto site they could just as easily represent the result of taphonomic forces operating on the assemblage. The element representation data for red deer, cattle and sheep/goat are similar to those for Phase 5, obtained from this study.

Other species

Twenty three seal bone fragments were retrieved from this sub-phase, of which 21 were canine teeth, one an incisor tooth and one unfused phalanx (Cook 1997b, 43). Twenty of the canines, derived from at least four animals, came from the one context. A similar deposit of 29 canine teeth was retrieved from a post-hole lined with edge set stones, dated to Phase 4 (the intermediate phase between the cellular phases and the figure of eight phases). The cache of seal teeth is interpreted as a ritual deposit (Harding and Gilmour 2000, 23). The post-hole was one of a series of three, each about 1.30 m from the inner wall of the complex Atlantic roundhouse (ibid. 23). Teeth in deposits that have been interpreted as "ritual" are not rare in the Western Isles. The site at Dun Bharabhat, within 2 km of Beirgh on the Bhaltos peninsula, had a double line of disarticulated cattle teeth in an arc 0.6 to 0.7 m around the north-west side of the hearth (Harding and Armit 1990, 81). The wheelhouse at A' Cheardach Bheag, South Uist, had "some 17 – 20 red deer mandibles in an arc around its hearth" (Cook 1997b, 43) and at A Cheardach Mhor, also in South Uist, a deposit of 32 cattle teeth was found in a pit below one of the piers (Young and Richardson 1960, 141. The embedding of teeth into the floor (occupation surface) in an arc at around 0.6 metres from a hearth may represent a ritual activity. Alternatively, such features may have had a more prosaic function, such as safety devices to discourage crawling babies, or bare-footed adults, from approaching the fire too closely.

The context in which the 21 canine teeth from sub-phases 1a and 2 were found is not discussed by Cook, who concludes that the seal teeth were a "highly prized ritual commodity". The collecting of seal teeth, for whatever reason, has a parallel in the butchered seal mandible discovered among the bones retrieved from Phase 5 (see 6.2.1.4).

Otter and cetacean bones were also retrieved from this assemblage, each with an NISP of 3. One human tooth, a premolar was also present. All could represent intrusive bones.

6.2.2.4 The results from Sub-phase 3

Bones from cattle, sheep and red deer were retrieved with NISP's of 12, 6 and 3 respectively.

6.2.2.5 The results from Sub-phase 3a

Another small assemblage was retrieved from this sub-phase. Red deer bones are the most numerous with an NISP of sixty-seven compared to 57 fragments of cattle bone. The other animals represented are sheep (NISP of 23); pig (4); cetacean (4); and horse, represented by one tooth. Most skeletal parts were present for cattle and the body part representation graph shows mandibles, proximal radius and ulna, and astragalus being the most abundant elements (Cook 1997b, 48, Figure 23). They are all structurally dense bones and this fact might explain their survival. Likewise the sheep body part representation reveals distal humerus and proximal phalanges to be most abundant (Cook 1997b, 50, Figure 24). With the red deer body part representation the distal tibia and the astragalus are relatively over-represented, compared to their representation in the skeleton (Cook 1997b, 52, Figure 25). The distal tibia, the most abundant element from red deer, the most abundant species in this sub-phase, is present at just below 18 on the x-axis of Figure 25 (ibid.) which shows "% of bones". Assuming that "% of bones" means the percentage of the bones retrieved (= NISP of 67) then the number of distal tibia present in the assemblage is 12. Hence the relative over-representation of the tibia is more likely to reflect better survival than it is to represent any detectable economic change.

6.2.2.6 The conclusions drawn from Late Iron Age occupation layers at Beirgh

Despite a totally different methodology and analytical approach, the conclusions reached by Cook largely concur with the conclusions in Chapters 4 and 5 above. Red deer are treated differently from the other large mammals, differing in the age at which they are killed and in their body part representation. The latter suggests the animals were introduced to site already butchered. Cook (1997b, 58) interprets the red deer evidence as suggesting co-operative hunting and feasting and deduces a high status position for the site. An alternative explanation could be that they were supplied from elsewhere; either a site of lower status providing food as payment or exchange; or from a site of higher status providing food as a charitable act. Living in the remains of a complex Atlantic roundhouse might bring regard as people of high status, as Cook suggests (ibid. 58), but equally well might be regarded as indicative of low status. Why continue living in a constantly flooding midden in a loch, surrounded by the debris of the ancestors if you could live elsewhere?

6.2.3 Comparison with Cnip

The site of Cnip (pronounced Neep) also on the Bhaltos peninsula has been referred to throughout this study. Details of the structures and chronology of the site are given below in the interests of completion, but the animal remains are not discussed thoroughly. This is because the most important points raised by McCormick have been discussed elsewhere (6.1 above) and because radically different approaches to analysis and to data presentation were followed by McCormick (forth.) from those pursued in this study.

6.2.3.1 The structures at Cnip

Cnip was excavated in 1988 by Ian Armit and revealed two adjoining wheelhouses, several cellular structures and a substantial linear house structure. The first occupation phase, Phase 1, comprised the two wheelhouses, the construction of one of which was never completed, but left with construction material stacked inside it (Harding and Armit 1990, 84). The building, known as Structure 2, was used for a short time as an annexe to the completed wheelhouse, (Structure 1). Both structures were revetted into the sand and the upper parts packed with sand material.

Phase 2, the cellular structures comprise six separate structures built after Structure 1 had been abandoned (Harding and Armit 1990, 91). The transition process is believed to have been gradual (Armit 1988) and some of the cellular structures reused parts of Structure 1.

Most of the cellular structures were constructed using a lower course of vertical slab-revetting topped by conventional wall coursing (Harding and Armit 1990, 91). The larger structures in this phase were Structure 4, and the reused Structure 1. Other cellular structures, 3, 5, 6 and 7 were small storage units believed to be too small for human occupation (ibid. 92).

The linear structure comprises the domestic focus of Phase 3 and overlies and seals all the cellular structures and wheelhouses of the preceding phases and used the entrance passageway and some of the earlier walling for foundations (Harding and Armit 1990, 92). This building is Structure 8 and is similar to the Early phase (Phase 1) of occupation at Bostadh (see figure 1.2).

6.2.3.2 The chronology of the site at Cnip

A suite of radiocarbon dates dated the Cellular phase (2), to cal AD 1 to cal AD 100 and the Rectilinear Phase (3) to cal AD 100 to cal Ad 250 (Church 2002, 60). The dating material used was cattle, pig and red deer bone, which introduces potential bulk and reservoir effect errors. Despite this the Cellular and Rectilinear phases were tightly dated, but a wide range of dates, from mid first millennium BC to late first century AD, were obtained from the wheelhouse occupation (Armit 1996, 146). A putative votive deposit of articulated cattle bone placed behind the wall of Wheelhouse 2, which ought to date the construction of the complex fairly accurately, gave a date centred in the fifth century BC (Armit 1996, 146). Animal bone is not ideal for dating purposes in coastal environments (see 1.1.6). However, the articulated cattle bones presumably would have been placed there during construction so Armit's (1996, 146) conclusion that there is little chance that the building was built any later than the third century BC seems plausible.

6.2.3.3 The animal bone from Cnip

The animal bones from the excavations at Cnip have already been mentioned in connection with the role of red deer on the Outer Hebrides (see 6.1). There are problems in comparing the results obtained from the animal bone assemblages at Cnip (McCormick forth) because NISP figures are not given except for each "block" analysed and there is no explanation of how the blocks relate to the phases. Table 1 (McCormick forth., 2) provides the proportions of species for each phase and for all three phases together as percentages of the total MNI for all species retrieved. This involves treating MNI as if it was a real number and not only adding several MNIs together but then calculating the percentage each one is of the total.

Table 2 (McCormick forth., 3 lists the relative percentages of fragments (presumably NISP) from various sites in the Western Isles including the results from Cnip, but unfortunately only the combined result for all three phases. Because of such differences in approach to analysis only the most basic observations can be made.

Cattle appear to be the most commonly represented species (41% of NISP for the site as a whole) with red deer and sheep comprising 25% and 29% respectively. McCormick uses other excavated sites in the Western Isles as *comparanda* for his study. Two of them, Northton, on Harris, and Dun Mor Vaul in Tiree are the only other sites with abundant red deer in the assemblages, but in some cases the assemblages are small, so a high percentage of the total will still be a small number of bones. For example, in Iron Age Phase 2 at Northton red deer appears to make up 88% of the bones in the assemblage, but only 313 identifiable bones were retrieved. Similarly at Dun Mor Vaul, on Tiree the percentages of red deer vary between 13 and 47 % but the numbers of bones in the assemblages are; 81, 440, 234, 73 and 376. Red deer are present at 41% of the assemblage from the "Pre-broch Iron Age" but only 81 identifiable bone fragments appear to be in the assemblage.

Age at death

McCormick found a high rate of young cattle deaths in what he stresses is a small sample (of 11 mandibles). There is a good correlation between mandibular and fusion data and both suggest that between 40 – 45% of the cattle died before one year of age (McCormick forth. 9). The neonatal death rate appears to have been lower than this at Bostadh and Beirgh, and the difference might be due to taphonomy although the taphonomy of the three sites is likely to be broadly similar, with the important exception of the sieving programme at Bostadh. However, it might also reflect differences in husbandry, in particular improvement in maintenance of young stock. Thirty six percent of cattle survived to beyond 40 months at Cnip, similar to the survival rate at Beirgh (36% surviving to over 36 months, Table 5.13). The cattle age at death figures from Bostadh are very variable (with between 26% and 75% surviving to over 36 months according to fusion data), probably reflecting the smaller sample sizes. The largest sample is from Phase 3 (n = 151) where the epiphyseal fusion evidence suggests a survival rate of 26% to over 36 months, and the mandibular evidence showing one out of three mandibles derived from an animal over 18 – 30 months. That mandible is from an animal that died at 30 – 36 months.

The age at death data from sheep at Cnip indicate a peak in slaughtering in the second six months of life, after the first summer and autumn. A second peak in slaughtering was noted in the second year of life at Cnip and interpreted as suggesting a shortage of grazing that prevented retention of the animals to full maturity (McCormick forth. 13). The fusion and dental evidence for age at death of sheep at Cnip are in agreement with each other. In Phase 3 at Bostadh a peak in slaughter rates is noted at the end of the first summer and autumn of life also (6 – 12 months). At Beirgh there seems to be heavy deaths at the end of the first and second years of life also.

The age at death of deer in the Cnip assemblage is more difficult to ascertain, because, as at Beirgh, no complete mandibles were retrieved. McCormick, presumably unaware of published fusion ages for red deer, has grouped the epiphyses into "age groups" according to the order in which they fuse in other animals. He concludes from the fusion data that few very young or fully mature animals were killed and that 60% were slaughtered when semi-mature (age groups 3 – 6, indicating animals aged 1 to 2 ½ years, based on epiphyseal fusion evidence from cattle and sheep.

The red deer evidence for age at death at Beirgh was derived from epiphyseal fusion data only and suggests a high percentage of deaths of deer in the older fusion age groups. Throughout all phases at Bostadh the age at death data for deer indicate a high proportion (over 50%) surviving past the age at which the late-fusing epiphyses fuse. The dental ageing evidence suggests some animals being killed at quite an advanced age (over 9 years) which might reflect selection of the older animals in the hunt as they are more easily killed.

6.2.4 Significance of Bostadh, Beirgh and Cnip within Atlantic Scotland

The apparent reliance on red deer in the Bhaltos peninsula and at Bostadh over the middle and Late Iron Age is unusual within Atlantic Scotland. It is unclear whether deer were ever present in Shetland, and they are believed to have died out in Orkney by the Late Iron Age. It seems likely that some form of management must have taken place in order for the animals not to have been hunted to extinction in west Lewis. Alternatively, perhaps there were, simply, sufficient red deer around to sustain the population at the level of human predation that existed. The other argument for management of any large herbivorous mammals is the need to keep them away from crops, but there is abundant ethnographic evidence that this can be done by children and dogs or by fencing. Deer are harder to deter by physical barrier such as fence or wall than are (modern breeds of) sheep or cattle. Pictures of planticrues in Orkney and Shetland illustrate that by using drystone wall construction, topped with turf and a row of sticks jutting out from the turf wall a suitable deterrent can be built (Fenton 1997, 101 - 105). A planticrue is a walled garden used for cultivating vegetable seedlings, particularly cabbage, until they are hardy enough to survive the wind in the unenclosed fields. The hypothesis that the movement of these animals, and of the domestic livestock, was controlled by construction of (perhaps seasonal) walls and fences is difficult, if not impossible to support with archaeological evidence. The mammal bone work done at Bhaltos and Bernera indicates red deer playing an important role in the economy and perhaps in the cultural belief system also. All the zooarchaeological evidence points to deer being treated differently from other animals in the Iron Age, which is perhaps surprising given the vastly different methodological and analytical approaches taken by the various workers who have tackled the assemblages.

Red deer have not yet been found in such abundance elsewhere in north Atlantic Scotland, but assemblage sizes are often even smaller than those in the current study and generally no consistent sieving program has been followed in the sites already published. It remains to be seen whether current work in South Uist by the Sheffield Environmental and Archaeological Research Campaign in the Hebrides, which employs a rigorous sieving and sampling programme, will reveal more about exploitation of red deer as they uncover earlier deposits. Red deer remains were found to be rare in the Iron Age deposits but their bones have been appearing in the assemblages retrieved from Bronze Age occupation layers (J. Mulville, pers. comm.). The maintenance of a sizeable herd of the animals, and sustained reliance on their meat over many centuries has not been noted elsewhere in the archaeological record from Atlantic Scotland as it stands today. By implication, the Bhaltos peninsula may have a unique economic base that allowed the flourishing of large monumental structures such as the complex Atlantic roundhouses at Beirgh and Dun Bharabhat, and the monumental wheelhouses at Cnip.

6.3 Conclusion

The ecology of the three main species retrieved from the assemblages from Bostadh and Beirgh have been discussed with a view to gaining a better understanding of how the humans and other animals might have interacted in prehistory. The importance of gaining an understanding of animal behaviour and ecology has been stressed and the archaeological implications of animal management systems very different from those familiar to most people today were considered.

The results from the mammal bone analysis from both sites were compared and discussed, and then two other assemblages from west Lewis were introduced and considered in relation to the findings from Beirgh and Bostadh. The conclusion was reached that the Bhaltos peninsula and the nearby island of Great Bernera had an economic strategy in the Late Iron Age that is, as yet, unique in the archaeological record. The apparent wealth of the resource base, which featured red deer, shellfish, fish, birds and domestic animals, allowed the construction of monumental architecture, the impressive remains of which are still upstanding today.

Chapter 7: The main research questions addressed through analysis of the faunal remains from Bostadh and Beirgh

7.0 Introduction

This concluding chapter addresses the original research aims outlined in Chapter 1 and discusses how far the evidence obtained from the animal bone assemblages from Bostadh and Beirgh, together with other evidence from elsewhere in Atlantic Scotland, has enabled the research questions to be answered. The chapter is a summary of the thesis and, as such, introduces no new data or information.

7.1 Transition and continuity

7.1.1 Transition and continuity at Bostadh

At Bostadh red deer appear to increase in importance through time, both relative to other species and in absolute numbers, according to the traditional quantification methods of MNI, NISP and relative weight. The assemblages are small, however, and vary in size, suggesting that taphonomic factors are influencing the results. This is confirmed by the count of homologous elements, designed to overcome some of the effects of taphonomy and differential fragmentation. The homologous elements data confirm that, relative to cattle, red deer increase in importance over time and sheep become relatively less important, particularly in Phases 3 and 4. The continual exploitation of red deer through all four occupation phases suggests continuity of tradition and, possibly, of methods of obtaining deer throughout the time the site was occupied. There is evidence that the importance of red deer may have increased over time and this may have been because of better hunting practice or improved trading connections. It might also indicate an increase in the number of deer available in the area, which might reflect good herd management through improved culling, in turn made possible due to enhanced/better hunting ability. Conversely, poor management, or no management at all might have resulted in an increase in deer numbers that may have brought about a situation similar to that found in the Scottish highlands today where population pressure forces deer off the hillsides due to lack of food. In the Late Iron Age and Norse period this would have made them more vulnerable to predation by humans, particularly in the case of the older animals, and hinds with young calves, that may have been attracted to settlements by the crops growing there. It would have been simpler to trap them there than it would have been to run them to ground on the hills. The admittedly small amount of horse bone retrieved indicates small animals the size of Shetland ponies today, rather than fast hunting steeds. Likewise there is no faunal evidence of large dogs from Bostadh that might have been used for hunting deer. Of course arguing from absence of evidence is unwise and it is possible that horses (or at least good sized ponies) and hounds were present but were disposed off differently from kitchen waste.

The body part representation evidence for red deer suggests a change in the way they were taken onto site in Phase 4. There is a preponderance of bones from the hind limbs appearing in the Phase 4 contexts suggesting some deer meat was taken onto site as jointed quarters, perhaps suggesting trading links, or possibly reflecting sharing of food after communal hunting. There is also a predominance of high meat yielding bones from red deer in Phase 4, which is not the case in the earlier phases which again hints at trading of meat in the Norse occupation phase rather than taking whole carcasses onto site.

The age at death evidence for deer does not indicate any change in hunting practice with the arrival of the Norse; such changes might include a variation in the age at which animals were most likely to be culled. However, ageing evidence from Phases 1 and 2 is scant.

Cattle are economically important throughout the occupation of Bostadh. The homologous element data suggest cattle consistently represent one third of the animal bone assemblage throughout all four phases. The evidence from body part representation analysis suggests a change in cattle procurement in Phase 3 with an imbalance in the numbers of hindquarters and forequarters present in the assemblage from Phase 3 which is not the case in the other phases. This may suggest trade, either the importation of hindquarters or the export of forequarters. The meat yield figures similarly indicate that Phase 3 is different, with much higher proportions of low meat yielding bone relative to high meat yielding bone being retrieved from contexts deriving from that phase than was the case in the other occupation phases. During Phases 1 and 4 the amounts of high and low meat yielding cattle bone was roughly equal. In Phase 2 there was nearly twice as much low meat bone than high meat bone retrieved and in Phase 3 there was three times more low meat yielding bones (of the lower leg and foot) than high meat yielding bones retrieved. This suggests a change in processing practice and might reflect trade in beef taking place off site. More likely, however, due to the small numbers of bones retrieved, is the possibility that use of abandoned buildings for butchery has increased the amount of butchery waste present in the retrieved assemblage. Such an episode was detected in House 1 during Phase 3.

The age at death epiphyseal fusion data for cattle does not reveal large numbers of cattle dying young (7 – 10 months) and indicates that the animals were maintained over the winter up to the age of prime maturity for meat production. Likewise, there is no evidence of high neonatal deaths in cattle with neonatal elements comprising 7% of the total assemblage in Phase 1 and decreasing through the phases to less than 1% of the total retrieved assemblage during Phases 3 and 4. This might indicate an improvement in farming methods with the arrival of the Norse. The dental attrition evidence reflects this trend with all mandibles retrieved from Phases 1 and 2 deriving from neonatal (0 – 1 months) and young (1 – 8 months) animals. Three mandibles were retrieved from Phase 3 and the dental attrition evidence indicated they were from one young animal; one animal of 18 – 30 months at time of death; and one animal that died between 30 – 36 months. Six cattle mandibles were retrieved from Phase 4 and represented a range of ages at death, including one young animal and one fully mature adult. The age at death evidence for cattle indicates husbandry practice may have improved over time and that the Norse had the ability to keep cattle to full maturity, which would have allowed their use for milking and traction. Hence the increase in hunting or trading in red deer would not have been necessitated by the lack of cattle meat, or other failures in farming methods or techniques.

The relative proportion of sheep in the assemblages from Bostadh decreases through time from around 40% of the assemblage in Phase 1 to around 25% of the assemblage in Phase 4. In absolute terms the retrieved NISP for sheep (and for sheep/goat) increases through Phases 1 to 3 then decreases in Phase 4. The MNI jumps from 3 to 7 between Phase 1 and Phase 2, and then stays at 6 and 7 respectively for Phases 3 and 4. It is unlikely that these figures represent any real change in the importance of sheep as a domestic animal and source of food and secondary products over time.

The body part analysis indicates that sheep were introduced to site as whole carcasses and there is no evidence to suggest trading in, or exchange of, parts of sheep carcasses. The age at death data for sheep/goat are impaired by their paucity somewhat but there is an indication of a greater proportion of animals dying at the end of their first year of life (during the first winter) in Phase 3 than in any of the other phases. This might reflect difficulties with husbandry in the Late Iron Age / Norse transition phase, but might equally be a product of taphonomy or the result of the death of just one or two young lambs for a specific purpose, such as a feast, or the use of the skins.

Direct faunal evidence of the occupation of the site by a seafaring people with contacts outside the Western Isles was obtained in the form of a mandible from a pine-marten which was retrieved from a context dating from Phase 4, the Norse occupation phase.

Otter bones were retrieved from all four phases but only in the Norse phase (4) did any of them display signs of butchery. The four butchered otter bones retrieved from Phase 4 all had the sort of knife marks on them that would indicate the removal of the pelt. One of the bones was derived from an almost fully-grown but immature animal. It can be seen that the Norse were using otter skins.

The number of species represented on site increases between Phase 1 and Phase 2, decreases in Phase 3 then increases again in Phase 4. Phase 3 has the smallest number of species represented, of all the phases, and also the greatest number of specimens identifiable to species, so the relative lack of species is not likely simply to be an artefact of small sample size. The relative lack of species represented in Phase 3 might confirm the hypothesis that it is a transitional phase representing the reuse of a deserted building for butchering. Certainly some of the animal bone deposits seem to derive from such activities. Although Houses 1 – 3 are believed to have been deserted at this time there is no reason to suppose, from the structural evidence, that the rest of the inhabited area was abandoned when this temporary reuse of House 1 was happening. Indeed, since the structures excavated are not known to correspond to the limits of the inhabited area it seems possible that people were living nearby during Phase 3, using the abandoned house for butchery and for the dumping of refuse, or deliberate maintenance of middens, until, perhaps, it was covered by sand.

Taphonomic indicators do not suggest that the condition of the bones worsened over time as the bones in all occupation phases are in a similar condition. Likewise, there is a roughly similar amount of attrition of bone by carnivores, which has been low throughout the occupation at Bostadh.

7.1.2 Transition and continuity at Beirgh

The results from the Late Iron Age occupation phases (1 – 4) are surprisingly similar to those obtained from Phase 5. The present author made a deliberate effort to ignore the detailed evidence from the work done previously in the area to avoid being influenced while carrying out the analysis. In fact the two reports available were not studied in detail until after completion of the current author's analysis and conclusions. Some similarities in the results are to be expected. The relative lack of sheep/goat remains on the site reflects the consistent lack of sieving from the upper occupation levels that were examined. At Beirgh the red deer bones make up around a third of the assemblage when quantified by NISP or weight. The MNI figures suggest that red deer were more abundant than cattle on site during Phase 5, with figures of 34 and 20 respectively. The MNI figures obtained for Late Iron Age phases 1a and 2 were similar, at 34 and 19 for red deer and cattle respectively, but as different analytical methods were employed this is presumably coincidence.

Continuity was noted throughout the Cellular Phase (Phase 5, analysed in this study) and the later occupation phases, in that red deer were being treated differently from cattle and sheep/goat. This was most noticeable in the body part representation analysis where a comparative lack of the low meat-bearing bones relative to elements that yield more meat, suggested deer were imported in jointed segments, rather than as complete carcasses.

For cattle and sheep/goat the body part representation analysis indicates preferential survival of dense, compact bones such as the astragalus, calcaneum, phalanges and teeth during Phases 1 to 4. In Phase 5 the astragalus and calcaneum were over-represented, compared to the other elements, possibly due to their distinctive morphology making them more visible in the trench and more readily identifiable to species on the analyst's bench.

7.2 The benefits of a mixed economy

The faunal evidence indicates that the people living at both sites benefited from a mixed economy and employed economic strategies that allowed them to obtain a range of food. Even when the word "economy" is defined in its strictest sense as meaning agricultural economy (excluding other food procurement strategies) it is evident from this study that a diverse mixture of animals was kept for food. Cattle, sheep and pig were present during all occupation phases of both sites. Cattle and sheep may have also provided milk, as animals survived to maturity on both sites. There was no evidence for heavy neonatal death, but arguing from lack of evidence is inadvisable, particularly when taphonomic losses are believed to be heavy. There is evidence of cattle dying at the end of their first summer, which would allow them to wean from their mothers and grow a bit on the plentiful summer grass, then be killed before requiring supplementary feeding over winter. Milk, therefore, was probably a resource available to the people at Beirgh and Bostadh.

Interpreting the word "economy" as the management of any material resources, gathered or hunted as well as farmed, illuminates a very mixed system / economy with use of fish and shellfish and plant resources such as seaweed for fertiliser, berries for food, and wood for fuel. Red deer were an important resource at both Bostadh and Beirgh, and seal and horse carcasses were butchered. Sea mammals like seals and cetaceans provide oil and skins yet their exploitation might not result in bones being deposited on site. Whale bones may have been left on the beach after defleshing, unless required for building purposes. A whale vertebra was found in a doorway at Bostadh and was interpreted as having been used as a door pivot. No attempt has been made to identify wealth or status through the animal bone evidence but as both sites were occupied for several centuries their economies must have been viable. Birds and eggs were another available resource and may have been used as a dietary supplement, particularly in the spring when little else is available. In a coastal environment it is possible to subsist on resources such as shellfish and small migratory coastal fish such as saithe when domestically produced food is in short supply. Bhaltos is ideal for obtaining a range of resources, providing access to a variety of shoreline habitats as well as upland resources, both plant and animal, and food of various types would have been available the whole year round. Bhaltos may have supported a reasonably large population throughout prehistory, indeed there may have been more people living there in the Iron Age than there are today.

Evidence of another non-domesticate, the grey seal, was obtained from Bostadh, but there was no reason to think that most of the ten bones retrieved represented human activity as they came from wall cores and may have been in the sand when the houses were built. One epistropheus (neck vertebra) displayed cut marks and may have been derived from the beheading of a seal for some unknown purpose. A seal mandible bearing butchery marks near the canine and incisor teeth was retrieved from the Phase 5 deposits at Beirgh. Removing the teeth could have caused the marks. A cache of seal teeth was retrieved from a Phase 4 deposit at Beirgh so the teeth may have had some practical or symbolic importance. It is possible that the butchery marks on the seal mandible from Bostadh resulted from the removal of the teeth and, further, that the teeth were removed to be put to the same purpose as those at Beirgh.

7.3 Animal husbandry methods

There is no evidence of poor animal husbandry, such as high neonatal death rates at either site, but the inadvisability of arguing from the absence of this particular evidence has been stressed previously. Bones from young and neonatal animals are more fragile, and so less likely to survive in an identifiable condition than are bones from older animals. In addition, they are less readily identifiable to species than are the fused bones from older animals. In the case of pigs it is likely that all or most of the carcase of the young animal was cooked for consumption, a process which further weakens the bone.

Therefore for taphonomic reasons alone young animals will be under-represented in an assemblage relative to bones from more mature individuals. There is evidence that both cattle and sheep were over-wintered successfully and that some calves were killed during their first summer indicating that milking of cattle would have been possible. There was no sign of pathological alteration on any bone, or of morphological changes associated with traction or injury. Pig bone is present in the assemblages from both sites and indicates the keeping of mature animals, presumably ensuring a regular supply of piglets. Pigs, being omnivorous, will survive on any surplus food, including meat, fish and vegetable waste. Both sites have structural evidence for abundant small buildings or cells that could have housed a pig.

7.4 Red deer - hunted, traded or managed?

At Bostadh, the age at death evidence for red deer indicates that quite mature animals (over 4 – 6 years of age when killed) were being caught and the dental attrition evidence suggests animals older than 8 – 12 years are present in the death assemblage. Even allowing for the likelihood that the sand contained in the machair soils accelerated dental attrition it seems clear that mature animals were obtained for food, and possibly antlers. There was no evidence of deformed antlers from castrates, or of large amounts of young and neonatal deer in the assemblage. Other workers studying Atlantic Scottish bone assemblages have interpreted both these forms of faunal evidence as indications of the probable domestication of deer. One neonatal mandible from red deer was retrieved but it may have been a foetal animal or a young calf caught with its mother. The generally high age at death of the red deer strongly suggests they were not domesticated as domesticates consume precious resources and, if wanted for meat, tend to be killed at their prime. For an animal the size of a red deer this would be around the age of three to four years.

The analysis of the animal bone from Phases 1 to 4 at Beirgh was carried out by another worker and despite radically differing methodological and analytical approaches the conclusions drawn about red deer are similar to those drawn about the role of red deer during the Phase 5 occupation of Beirgh. In particular the evidence from the later phases (1 – 4) suggests that red deer were taken onto site in a partially butchered state. There are proportionately more high meat yielding bones of red deer than is the case for sheep or cattle. This corresponds well to what was discovered to be the case in Phase 5 at Beirgh and in Phase 4 at Bostadh.

In conclusion, the evidence from Phase 5 at Beirgh and from Bostadh does not suggest that the red deer were in any sense domesticated, as there is a lack of animals in the assemblage at the peak of maturity and a larger number of older animals than would be expected in a domesticated herd. The age at death evidence has been interpreted as indicating an economy based on hunting. Whether or not attempts were made to manage the herd is unresolved, but some method of removing animals from growing crops must have been employed. In addition, the fact the red deer numbers were sustained over many centuries suggests some sort of control over the hunting of the animals. Certainly they were not hunted to extinction as seems to have been the case in the Iron Age in Orkney. At Bostadh there seems to be a relatively greater reliance on red deer over time, and at Beirgh there is no evidence to suggest that the exploitation of deer was any less in the later phases than it was in Phase 5. Different methodological approaches by different workers make it hard to be any more specific about change in exploitation patterns at Beirgh.

Evidence for trading in red deer does seem to have been detected in the faunal remains, with surplus forequarters being present at Beirgh and surplus hindquarters present in the assemblages from Bostadh. The occupation phases of the two sites for which these results were obtained are believed to be non-contemporaneous. Thus trading between them cannot be proposed.

7.5 Use of birds as a food resource

Birds and their eggs are available in the spring when other food resources may be scarce. With the exception of one butchered bone however, all the bird bones could represent intrusive material as they were mainly retrieved from wall-fill and from windblown sand contexts at Bostadh, and all species present in the assemblage might have used abandoned buildings for nesting. It is, however, possible that some at least of the bird remains represent food waste and that would indicate that various species of birds locally available around the shoreline were used as a food resource. With the use of nets, birds could have been caught as they moved to and from their nests on the cliffs and cliff tops. Similarly birds and eggs could have been collected from cliffs by climbing, with or without the aid of ropes. There is abundant ethnographical evidence for the exploitation of birds and their eggs throughout recent history both in northern and western Scotland and other Atlantic locations. Bird remains were scarce at Beirgh, probably reflecting the fact that sieving was not routinely carried out over all seasons of excavation.

7.6 Faunal evidence of seasonality

It was hoped that the faunal evidence might indicate whether or not any use had been made of transhumance in Bhaltos in the Late Iron Age. The practice of removing animals to hill land distant from the settlement during the summer months is known from historic and ethnographic sources. Traditionally the animals would be accompanied by young people who stayed in huts or bothies on the hills tending and herding them. This would have kept the crops adjacent to the main settlements safe from marauding by the domesticated animals at least, and would have had the further benefit of encouraging socialising between young people from the various settlements.

No obvious gaps in the age at death data were noted so no direct evidence of seasonality or transhumance could be gleaned. There was a slight lack of neonatal deaths, particularly compared to other sites in the area. It is possible that this could represent the removal of the animals from the site for the spring and summer to protect growing crops. However, it is just as likely to reflect taphonomic processes, which are known to have strongly affected bone survival.

7.7 Other animals– pelts, pest control and hunting

There is evidence that otters were skinned in the Norse occupation phase at Bostadh. There was no evidence of cat, other than four immature bones, which might be intrusive. Very few rodent bones were retrieved, and few bone fragments displaying indicators of rodent gnawing were observed. Butchery marks on seal bones was interpreted as evidence of hunting seals at Howe in Orkney, and butchered seal bones were retrieved from Beirgh. Seals would have been valuable for their skins and for their subcutaneous fat that could have been burned in lamps and fires. Their meat could have been eaten and their teeth, bones and claws used for functional and decorative purposes.

7.8 The social and symbolic functions of animals

Despite the presence of under-floor pits at Bostadh that had been observed to contain animal bone during excavation, no evidence of structured deposition at the site was noted. All the faunal material could have been deposited accidentally. However, the possibility that parts of animals were placed in foundation pits for spiritual or superstitious reasons cannot be ruled out and the bones in the pits may represent structured deposition of material in accordance with some sort of belief system. In tombs dating from Neolithic Orkney the burial of remains of animals is generally believed to indicate the creatures had some sort of totemic significance to the tomb users. It may well be that similar beliefs led to the inclusion of animals, or parts of animals in foundation deposits beneath floors in structures built for the living during prehistory as well. As we cannot hope to understand what these beliefs may have been further speculation seems fruitless.

At Beirgh there was evidence of a cache of seal's canine teeth from Phase 4, and of butchered seal mandibles in Phase 5. The butchery marks were on the appropriate part of the bone for the removal of canine teeth. The teeth may have had some sort of ritual significance, or they may have been used as decoration, in jewellery for example. There are examples elsewhere in the Western Isles of teeth and mandibles, of various animals, being arranged around hearths. While they have been interpreted as ritual deposits it is equally possible that they served some more prosaic function, teeth being a naturally durable, resistant material they may have had some protective function near a fire.

7.9 Further work

Further work needs to be done with the results obtained from this research to make them available to other interested workers as well as to the public in general. This should take a variety of forms. The results obtained from this research should be summarised into a more concise, illustrated format for each site and for the two sites together. These reports should be published, or otherwise disseminated, certainly within the Western Isles and elsewhere in Atlantic Scotland. This would facilitate comparison with the results obtained on other Atlantic Scottish sites and provide other workers with a readable and accessible summary of the results.

Then, an integrated report synthesising all the environmental results from the work done on the sites of Bostadh and Beirgh should be produced and published in an appropriate journal. The chance to integrate faunal data with that obtained from the results of other environmental research was one of the main things that attracted the author to the idea of studying these assemblages for a PhD thesis. In the early days of the research a detailed research agenda was drawn up to facilitate this process. In fact the opportunity did not really present itself due to different approaches to progressing with the analysis; different research aims within each piece of doctoral research; and deadlines within which the research had to be completed. It is hoped that further integrated work can now be carried out on the information obtained from both sites to see how the four strands interweave to form one picture of the environmental dimensions of the Iron Age in the Western Isles. This will form part of the forthcoming book on Bostadh. Similarly, the results from Beirgh will be integrated with other evidence, both environmental and artefactual, and published in the next volume of the Beirgh report.

The research questions originally devised include methodological questions regarding the success or otherwise of the sampling programmes executed at Bostadh and Beirgh. Such issues would include some consideration of the general effectiveness of a total bulk and routine sampling programme used in conjunction with adaptive sampling for recovery of certain artefact types in the context of machair and rescue excavations. More specific sampling issues could also be addressed such as the effectiveness of column sampling of putative "occupation" horizons and the usefulness of the results gained from the highly labour intensive magnetic susceptibility grids and close interval sampling of putative floors. Consideration of the returns, in the form of knowledge gained, as against the considerable cost, in both time and money, of executing an extensive sampling programme could be given. This information would be valuable and instructive to other workers embarking on similar sized excavations in Atlantic Scotland, or indeed other areas with good preservation of environmental evidence and should be made available to the archaeological community as soon as possible.

It may be that the research potential of the material excavated from those sites has not yet been exhausted, although clearly there is a pressing need to publish what findings have been made as swiftly as possible before any further research is embarked upon.

The second set of research questions deals with the internal and external site formation processes. The questions relating to the internal structural site formation processes are concerned with the materials used in the construction of the buildings; what materials were used to lay the floors; how were the floors used and how long it took for the putative floor deposits to accumulate. The question of how the formation of "floor deposits" corresponds with the formation of other accumulations of sediment around the site is also of interest, as is the issue of structured deposition, symbolic placement of materials such as animal bone and plant remains in significant places. Similarly there is the possibility that certain incongruous floor deposits may represent material brought into the house and laid on the floor for spiritual or symbolic reasons.

Site formation processes external to the structures are obviously of interest as well. The houses were built into the notoriously unstable environment of the machair so measures must have been taken to stabilise the houses in the machair as well as stabilising the machair immediately surrounding the houses. Without such measures the structures would have faced constant inundation by sand, so if no evidence for machair stabilisation is found there are implications for site formation processes inside the houses, in particular the timescale in which the sand layers accumulated.

Another aspect of site formation processes that is of interest to environmental archaeologists is the taphonomy of ecofact deposition. An ecofact can be defined as any piece of environmental data, from pollen grain to whale vertebra, and the identification of the taphonomic pathways that such items followed and how their occurrence on site and their preservation varies across space and through time is an important study goal. The site formation processes that occurred after abandonment and whether they can be distinguished is another objective.

Possibly the most exciting aim of archaeological research is the reconstruction of the environment and economy of the past. The analysis of the macroplants and marine and terrestrial animal remains from the sites should enhance our understanding of the relative importance of different foods to the people and whether this changed over time. It seems likely that the Norse would have brought crops and animals with them when they arrived. Developments in fishing technologies, including improvements in seamanship, would have increased the range of fish available. Improvements in husbandry practice and in hunting abilities would have led to better availability of meat and other animal products, just as deterioration in either of these, due to loss of knowledge, or reduction of resources would have led to less animal products being available and greater reliance on plant foods.

The methods used to grow and process crops are also interesting and many of them integrate the different lines of evidence. The use of middens to fertilise the fields, and the introduction of seaweed and other plant material, together with manure to the land to improve, or even create, soils is described from ethnological sources in the Western Isles as well as from Orkney and Shetland. There may be evidence for such practices occurring in the Iron Age in the north west of Lewis and Greater Bernera. The various strands of evidence should indicate something about soil creation and maintenance.

The faunal evidence has indicated that red deer played an important role in the economy, probably representing the use of what was a natural, though possibly controlled, resource. Other natural resources may have been harvested, wood for building and fuel, may have been available as driftwood from the sea. Peat may have been cut for burning, and the ash from the fire may have been used as animal bedding. A by-product of crop-processing, straw, may have been used for animal food and/or bedding and then put in a midden for spreading on the fields.

Molluscan evidence for spreading seaweed on the land was obtained from the Bhaltos data and other exploitation of molluscs and fish to benefit the farming practices may well have existed. There is, for example, ethnographic evidence for feeding seaweed and even fish to cattle in early spring, when agricultural food sources are not available yet marine resources may be at their most abundant.

While the evidence from the terrestrial animals and birds did not illuminate seasonality particularly well the other strands of environmental evidence may do so. It is anticipated that a calendar of available resources can be constructed in order to reconstruct possible dietary habits. Certain migrating fish are seasonal in their availability today and it may be assumed they followed similar patterns in the past. Similarly, there are times in the lunar / tidal cycles when certain species of molluscs are more accessible than at other times. There is likely to be evidence from buildings and floor deposits to support the faunal evidence for the over-wintering of animals at both sites. Crop processing evidence may shed some light on the potential availability of straw and other fodder for animals during the winter. The soil micromorphology may indicate the presence of animal dung and ash or peat bedding waste being incorporated into floors.

This thesis has indicated evidence for a possible episode of animal processing discovered at Bostadh and similar instances of crop processing may have been identified. Fish and shellfish processing, which similarly would be expected to leave physical evidence, may have been noted.

Further integration with the more "traditional" artefacts associated with archaeology, the "finds" generally retrieved from excavation, such as pottery fragments, worked bone implements and agricultural tools may reveal more about the environmental evidence. The site of Bostadh produced several artefacts about which little can be guessed, including a piece of worked whale bone with holes bored through it that may have been used for separating ropes, for fishing or tethering purposes.

More work could be done into the social evidence that might be gleaned from the data by a worker taking a more interpretative approach. There has been a lot of interpretative work done in recent years throughout Atlantic Scotland which has been largely ignored in this thesis due to the author's scepticism. It may be worthwhile revising the prosaic interpretation of the under-floor pits if other materials have been found in them. Similarly, the evidence of trading demonstrated in the pine-marten mandible will probably be backed up with other forms of environmental and artefactual evidence as this is drawn together in due course. Further work could be done in investigating evidence for feasting and the sharing of food, as was believed to have happened with deer at Beirgh. The question of food storage could be examined, particularly in the light of recently completed research into the pottery assemblages of the area.

The combination of the different strands of environmental evidence will allow a picture of the general land-use pattern to be built up, with some clues to detailed landscape formation processes perhaps coming to light with the soil results. Changes in soils structures may reveal something of climate change. Climatic change may also be indicated by warmer water fish species present in the assemblage than are found in the area today.

The fourth area of research interest is the issues raised by chronology. The evidence should be assessed for both sites as an intra-site comparison, studying the differences between the phases. In the case of Bostadh this will allow a detailed study of the impact of the Norse and the extent to which the environmental research programme reveals how the transition from indigenous to Norse occupation of the site may have taken place. In particular, whether the environmental evidence indicates sudden or gradual change and whether that can be interpreted as cultural change of a peaceful or warlike nature.

The environmental results from both sites should also be compared with each other, and, indeed, with other contemporaneous sites in the immediate area and within Atlantic Scotland. This will allow the research to be set in a wider context, and ultimately, perhaps, to contribute to the development of regional research frameworks for both environmental archaeology and for the study of the Iron Age.

The completion of this integrated paper will allow the true worth of the various research programmes to be judged and will be an important step in advancing knowledge about the Iron Age in the Western Isles, a relatively neglected field, particularly in the published record.

Some bones from the excavations at Beirgh remain unanalysed and it would be interesting to be able to analyse them in the same manner as has been carried out for the assemblage from Phase 5. The bones that have not yet been examined are from earlier phases before Phase 5, Phases 6 – 10, and it would be particularly interesting to compare the faunal assemblages from the two roundhouse occupation phases with the data obtained from Phase 5 and the later phases. Unfortunately the complex Atlantic roundhouse itself has not yet been excavated so the faunal material is unobtainable at present. Likewise, it cannot be known whether all contexts relating to the second roundhouse occupation phase have been excavated until the excavation is complete. It is unlikely that only contexts relating to one occupation phase remain unexcavated. Obviously the completion of this excavation would be of major benefit to Scottish archaeology. The opportunity to scientifically excavate a well-preserved complex Atlantic roundhouse down to its foundations has not arisen before, presumably due to the high costs entailed, which will similarly preclude the completion of this one. The costs will be particularly high in the case of Beirgh due to the lower layers being waterlogged. This waterlogging will make excavation more difficult, but will also enhance conservation of organic material thus greatly increasing the information that might be produced from the environmental remains. As the site is not under threat any further work on this scheduled ancient monument would have be done on a purely research basis.

More attention must be paid to locating, and sampling extensively, dumps and middens during excavations of Atlantic Scotland machair sites. The retrieval of bone from domestic contexts is always likely to reflect certain taphonomic biases that will mask the archaeological information that the bones might contain. More detailed investigation of midden deposits would allow a fuller picture of domestic waste disposal to be built up. The extensive and thorough sampling of middens in Bostadh produced an assemblage with a good and varied representation of both species and elements.

There would seem to be considerable scope for further investigation of the effect of sample processing on the type, size and quantity of animal bone retrieved from the excavations. A more detailed analysis of the bones retrieved from Bostadh, with particular reference to whether they were retrieved by hand or from the sample processing, would be beneficial. An in-depth statistical multi-variate analysis comparing the material from the hand-retrieved sample from Bostadh with that from the sieve-retrieved sample from Bostadh should illuminate what bones were under-represented in the hand-retrieved assemblage and that, in turn, will indicate what might be missing from the Beirgh assemblage.

It is clear that the research into the animal bone remains from Bostadh and Beirgh is just a small part of a much bigger research programme and that once that is completed there will be a greatly increased understanding of the economy and environment in the Iron Age in the Western Isles, in particular and Atlantic Scotland in general. The priority now is to publish the individual findings and to begin work on the integrated reports for both sites.

References

Anderson, J. 1878 'Notes on the structure, distribution, and contents of the brochs, with special reference to the question of their Celtic or Norwegian origin', *Proceedings of the Society of Antiquaries* **12,** 314 – 355.

Andrews, P. 1995 'Experiments in taphonomy', *Journal of Archaeological Science* **22**, 147-153.

Andrews, P. and Evans, E.N. 1983 'Small mammal bone accumulations produced by mammalian carnivores', *Palaeobiology* **9**, 289 – 307.

Angus, S. 1987 'Lost woodlands of the Western Isles', *Hebridean Naturalist* **9**, 24 – 30.

Angus, S. 1991 'Climate and vegetation of the Outer Hebrides', in Pankhurst and Mullin, 28 – 31

Armit, I. 1988a 'Broch landscapes in the Western Isles', *Scottish Archaeological Review* **5**, 78 – 86.

Armit, I. 1988b *Excavations at Cnip, West Lewis, 1988*, Dept of Archaeology, University of Edinburgh, Project Paper 9

Armit, I. (Ed.) 1990 *Beyond the Brochs.* Edinburgh, Edinburgh University Press.

Armit, I. 1990a 'Introduction' in Armit, 1–4.

Armit, I. 1990b 'Brochs and beyond in the Western Isles' in Armit, 41 – 70.

Armit, I. 1990c 'Broch building in northern Scotland: the context of innovation', *World Archaeology* **21**, 435-445.

Armit, I. 1994 'Archaeological field survey of the Bhaltos (Valtos) peninsula, Lewis', *Proceedings of the Society of Antiquaries of Scotland* **124**, 67 – 93.

Armit, I. 1996 *The Archaeology of Skye and the Western Isles*, Edinburgh, Edinburgh University Press.

Armit, I. 1998 'Human responses to marginality', in Mills and Coles, 31 – 38

Armit, I. forthcoming *Anatomy of an Iron Age roundhouse: the Cnip wheelhouse excavations, Lewis.*

Armit, I and Dunwell, A. 1992 'Excavations at Cnip, sites 2 and 3, Lewis, 1989', *Proceedings of the Society of Antiquaries of Scotland* **122**, 137 – 48.

Armit, I. and Ralston, I.B.M. 1997 'The Iron Age' in Edwards and Ralston, 169 – 193.

Ballin Smith, B. (Ed.) 1994 Howe, *Four Millennia of Orkney Prehistory, Excavations 1978 – 1982* Edinburgh, Society of Antiquaries of Scotland Monograph Series **9**.

Barker, G. and Gamble, C. (eds) 1985 *Beyond domestication in Prehistoric Europe*, Cambridge, Cambridge University Press

Barrett, J.H. 1993 'Bone weight, meat yield estimates and cod (*Gadus morhua*): a preliminary study of the weight method', *International Journal of Osteoarchaeology* **3**, 1 – 18.

Barrett, J.H. 1995 *"Few know an earl in fishing clothes": fish middens and the economy of Viking age and Late Norse earldoms of Orkney and Caithness, northern Scotland.* Unpublished PhD thesis, University of Glasgow

Barrett, J.H., Nicholson, R.A. and Cerón-Carrasco, R. 1999 'Archaeo-icthyological evidence for long-term trends in Northern Scotland: 3500 BC to AD 1500' *Journal of Archaeological Science* **26**, 353 – 388.

Barrett, J.H., Beukens, R., Simpson, I., Ashmore, P., Poaps, S. and Huntly, J. 2000a 'What was the Viking age and when did it happen? A view from Orkney', *Norwegian Archaeological Review* **33**, 1 – 39

Barrett, J.H, Beukens, R.P. and Brothwell, D.R. 2000b 'Radiocarbon dating and marine reservoir correction of Viking Age Christian burials from Orkney', *Antiquity* **74**, 537 – 543

Barrett, J.H., Beukens, R.P. and Nicholson, R.A. 2001 'Diet and ethnicity during the Viking colonization of northern Scotland: evidence from fish bones and stable carbon isotopes', *Antiquity* **75**, 145-54.

Bartosiewicz, L. and Choyke, A.M. 1991 'Animal remains from the 1970 – 1972 excavations of Latrus (Krivina), Bulgaria', *Acta Archaeologica Academiae Scientiarum Hungaricae* **43**, 181 – 209

Batey, C.E., Jesch, E.J. and. Morris, C.D. (eds.). 1993 *The Viking Age in Caithness, Orkney and the North Atlantic – select papers from the proceedings of the eleventh Viking congress, Thurso and Kirkwall 1989.* Edinburgh, Edinburgh University Press.

BBC News Online 2001 'Sheep taught to stay put', Saturday 3rd November 2001 *http:/news.bbc.co.uk/1/low/england/1634526.stm*

Bennet, K.D., Boreham, S., Sharp, M.J. and Switsur, V.R. 1990 'Holocene vegetational and environmental history at Loch Lang, South Uist, Western Isles, Scotland', *New Phytologist* **114**, 281 - 298.

Bennet, K.D., Boreham, S., Sharp, M.J. and Switsur, V.R 1992 'Holocene history of environment, vegetation and human settlement on Catta Ness, Lunasting, Shetland', *Journal of Ecology* **80**, 241-373

Binford, L.R. 1964 'A Consideration of Archaeological Research Design', *American Antiquity* **29**, 425 - 441.

Binford, L.R. 1978 *Nunamiut Ethnoarchaeology.* New York, Academic Press.

Binford, L.R. 1981 *Bones: ancient men and modern myths.* New York, Academic Press.

Birks, H.J.B., 1991 'Floristic and vegetational history of the Outer Hebrides', in Pankhurst and Mullin, 32 – 37

Birks, H.J.B. and Madsen, B.J. 1979 'Flandrian vegetational history of Little Loch Roag, Isle of Lewis, Scotland', *Journal of Ecology* 67, 825- 842

Birks, H.H., Birks, H.J., Kaland, P.E and Moe, D (eds) 1988 *The Cultural Landscape: Past, Present and Future.* Cambridge, Cambridge University Press.

Blaxter, K.L., Kay, R.N.B., Sharman, G.A.M., Cunningham, J.M.M. and Hamilton, W.J. 1974 *Farming the Red Deer,* Department of Agriculture and Fisheries for Scotland, Edinburgh, HMSO

Boessneck, J. 1969 'Osteological differences between sheep (*Ovis aries* Linne) and goats (*Capra hircus* Linne)', in Brothwell and Higgs, 331-58

Bohncke, S.J.P 1988 'Vegetation and habitation history of the Callanish area, Isle of Lewis' in H.H. Birks, H.J.B Birks, P.E. Kaland and D. Moe, 445 – 461.

Bökönyi, S. 1989 'Definitions of animal domestication', in Clutton-Brock, 22 – 27.

Bond, J. M. 1998 'Beyond the fringe? Recognising change and adaptation in Pictish and Norse Orkney', in Mills and Coles, 81 – 90

Bond, J. and O'Connor, T.P. 1999 *Bones from Medieval Deposits at 16 – 22 Copper gate and Other Sites in York, The Archaeology of York 15/5* York, British Council for Archaeology.

Bonsall, C., Cook, G., Lennon, R., Harkness, D., Scott, M., Bartosiewicz, L. and McSweeney, K. 2000 'Stable isotopes, Radiocarbon and the Mesolithic-Neolithic Transition in the Iron Gates', *Documenta Praehistorica 27*, 119 – 132.

Bramwell, D., Cartledge, K.M., Gilbertson, D.D., Griffin, C.M., Hunt, C.O., Jenkinson, R.D.S and Samson, C. 1984 'Steetley Quarry Cave: A lost interglacial site and Steetley Cave: A 5,000 year old badger den', in Jenkinson, and Gilbertson, 75 – 88.

Bramwell, D. with Ballin Smith, B., 1994 'The Bird Remains' in Ballin Smith, 153 – 157.

Brain, C.K. 1981 *The hunters or the hunted? An introduction to African cave taphonomy*, Chicago, University of Chicago Press.

Brothwell, D. & Higgs, E. (eds) 1969 *Science in Archaeology 2*, London, Thames and Hudson.

Brothwell, D.R. and Pollard, A.M. (eds) 2001 *Handbook of Archaeological Sciences*. Chichester, Wiley and Sons

Brown, W.A.B. and Chapman, N.G. 1990 'The dentition of fallow deer (*Dama dama*): a scoring system to assess age from wear of the permanent molariform teeth', *Journal of Zoology, London* **221**, 659-682.

Brown, W.A.B. and Chapman, N.G. 1991a 'The dentition of red deer (*Cervus elaphus*): a scoring scheme to assess age from wear of the permanent molariform teeth', *Journal of Zoology, London* **224**, 519 – 536.

Brown, W.A.B. and Chapman, N.G. 1991b 'Age assessment of red deer (*Cervus elaphus*) from a scoring scheme based on radiographs of developing permanent molariform teeth', *Journal of Zoology, London* **225**, 85 – 97.

Buckland, P. 1983 'Norsemen at Nipáitsoq, Greenland: A palaeoecological investigation'. *Norwegian Archaeological Review* **16**, 86-98.

Buckland, P.C., Sadler, J.P. and Smith, D.N. 1993 'An insect's eye view of a Norse farm' in C.E Batey, E.J. Jesch, and C.D. Morris, (eds.), 506 – 527.

Buckland, P.C., Amorisi, T., Barlow, L.K., Dugmore, A.J., Mayewski, P.A., McGovern, T.H., Ogilvie, A.E.J., Sadler, J.P. and Skidmore, P. 1996 'Bioarchaeological and climatological evidence for the fate of the Norse farmers in medieval Greenland', *Antiquity* **70**, 88 – 96

Budiansky, S. 1994 *The covenant of the wild: why animals chose domestication.* London, Weidenfield and Nicholson

Burton, J. and Price, T.D. 1999 'Evaluation of bone strontium as a measure of seafood consumption', *International Journal of Osteoarchaeology* **9**, 233 – 236

Byock, J. 2001 *Viking Age Iceland.* London, Penguin.

Callandar, R.F. and MacKenzie, N. A. 1991 *The management of wild red deer in Scotland*, Perth, Rural Forum Scotland.

Cameron, K. 2002 'The excavation of Neolithic pits and Iron Age souterrains at Dubton Farm, Brechin, Angus', *Tayside and Fife Archaeological Journal* **8**, 19 – 76.

Casteel, R.W. 1978 'Faunal assemblages and the '*Wiegenmethode*' or weight method', Journal *of Field Archaeology* **5**, 71 – 77

Cerón-Carrasco, R. 1993 'The fish remains from St Boniface', Unpublished report, AOC (Scotland) Ltd.

Cerón-Carrasco, R. 1997 Catalogue *of the hand-retrieved fish remains from Bostadh Beach, Great Berneraigh, Lewis, Project 1515.* AOC (Scotland) Ltd Report 1515.

Cerón-Carrasco, R. 1998 'Fishing: evidence for seasonality and processing of fish for preservation in the Northern Isles of Scotland during Iron Age and Norse times', *Environmental Archaeology* **3**, 73 – 80.

Cerón-Carrasco, R. 2002 *Of fish and men, De iasg agus dhaoine: aspects of the utilisation of marine resources as recovered from selected Hebridean archaeological sites.* Unpublished PhD thesis, University of Edinburgh

Cerón-Carrasco, R. and Parker Pearson, M. 1999 'The fish bones', in Parker Pearson and Sharples, 274 – 281

Cerón-Carrasco, R., Church, M.J. and Thoms, J. forthcoming 'Towards an economic landscape of the Bhaltos peninsula, Lewis during the Mid to Late Iron Age' in V. Turner (Ed.) *Tall Stories; broch studies, past, present and future.* Oxford, Oxbow Books

Chaplin, R.E. 1971 *The Study of Animal Bones from archaeological site,* New York, Seminar Press

Charles, M. and Halstead, P. 2001 'Biological resource exploitation: problems of theory and method', in Brothwell and Pollard, 365 – 378.

Church, M.J. 2002 *Plants and people in the later prehistoric and Norse periods of the Western Isles of Scotland,* Unpublished PhD thesis, Dept of Archaeology, University of Edinburgh

Clark, J. and Kietzke, K.K. 1967 'Palaeoecology of the Lower Nodular Zone, Brule Formation, in the Big Badlands of South Dakota' in Clark, Beerbower and Kietzke, 111 – 137.

Clark, J., Beerbower, J.R and Kietzke, K.K. 1967 *Oligocene sedimentation, stratigraphy and palaeoclimatology in the Big Badlands of South Dakota,* Fieldiana Geology Memoir **5.**

Clark, J.G.D. 1952 *Prehistoric Europe: The Economic Basis.* London, Methuen.

Clarke, D.V. and Sharples, N. 1985 'Settlements and subsistence in the third millennium BC' in Renfrew, 54 – 82

Clutton-Brock, J. 1979 'Report on the mammal remains other than rodents from Quanterness' in C. Renfrew *Investigations in Orkney* 112 - 135. London, Society of Antiquaries of London/Thames and Hudson.

Clutton-Brock, J. 1981 *Domesticated Animals*, London, British Museum (Natural History)

Clutton-Brock, J. (Ed.) 1989 *The walking larder: patterns of domestication, pastoralism and predation.* London, Unwin Hyman.

Clutton-Brock, J. 1992 'The process of domestication', *Mammal Review* **22**, 79 – 85.

Clutton-Brock, J. 1994 'The unnatural world: behavioural aspects of humans and animals in the process of domestication', in Manning and Serpell, 23 – 35.

Clutton Brock J. 1999 *A natural history of domesticated mammals,* 2nd edition, Cambridge, Cambridge University Press.

Clutton-Brock, T.H., Guinness, E.E. and Albon, S.D. 1982 *Red deer: behaviour and ecology of two sexes.* Chicago, University of Chicago Press.

Cohen, A. and Serjeantson, D. 1996 *A Manual for the Identification of Bird Bones from Archaeological Sites.* London, Archetype Publications.

Cook, M. 1997a *Catalogue of the hand-retrieved large mammal remains from Bostadh Beach, Great Bernera, Lewis.* AOC (Scotland) Ltd Report 1515.

Cook, M. 1997b *The Late Iron Age faunal assemblage from Beirgh, Riof, Isle of Lewis.* Report to the British Academy.

Darling, F. F. 1937 *A Herd of Red Deer: A Study in Animal Behaviour.* London, Oxford University Press.

Darwin, C. 1859 *On the origins of species by means of natural selection or the preservation of favoured races in the struggle for life.* London, John Murray.

Darwin, C. 1875 *The variation of animals and plants under domestication,* 2nd edition. London, John Murray.

Davidson, D.A. and Jones, R.L. 1985 'The environment of Orkney', in Renfrew, 10 - 35.

Davidson, J.L. and Henshall, A.S. 1989 *The chambered cairns of Orkney: an inventory of the structures and their contents.* Edinburgh, Edinburgh University Press

Davis, S.J. 1987 *The Archaeology of Animals,* London, Batsford.

Dincauze, D.F., 2000 *Environmental Archaeology: Principles and Practice.* Cambridge, Cambridge University Press.

Dobney, K. and Rielly, K. 1988 'A method for recording archaeological animal bones: the use of diagnostic zones', *Circaea* **5**, 79 – 96.

Dobney, K., Jaques, S.D. and Irving, B.G. (1996?) *Of butchers and breeds: Report on the vertebrate remains from various sites in the City of Lincoln,* Lincoln Archaeological Studies 5. Lincoln, City of Lincoln Archaeological Unit.

Dockrill, S. J. 1998 'Northern Exposure: Phase 1 of the Old Scatness excavations 1995–8', in Nicholson and Dockrill, 59 - 80

von den Dreisch, A. 1976 *A Guide to the Measurements of Animal Bones from Archaeological Site,* Harvard, Peabody Museum

Driver, J.C., 1992 'Identification, classification and zooarchaeology', *Circaea* 9, 35 – 41.

Ducos, P. 1989 'Defining domestication: a clarification', in Clutton-Brock, 28 – 30.

Edwards, K.J. and Ralston, I.B.M (eds) 1997a *Scotland: Environment and Archaeology, 8000BC – AD 100,* Chichester, Wiley & Sons.

Edwards, K.J. and Ralston, I.B.M. 1997b 'Environment and people in prehistoric and early historical times: preliminary considerations', in Edwards and Ralston, 1997a, 1 – 10.

Egorov, O.V. 1967 *Wild Ungulates of Yakutia,* Jerusalem, Israel Program for Scientific Translations.

Ellis, S. and Mellor, A 1995 *Soils and Environment,* London, Routledge.

Evans, J. and O'Connor, T. 1999 *Environmental Archaeology: Principles and Methods.* Stroud, Sutton Publishing.

Everett, M.J. 1983 'Seabird cliffs', in Hammond, 21 – 26.

Ewbank, J.M., Phillipson, D.W., Whitehouse, R.D with Higgs, E. 1964 'Sheep in the Iron Age - a method of Study', *Proceedings of the Prehistoric Society* **30**, 423 – 436.

Fairbairn, A.S. (Ed.) 2000 *Plants in Britain and beyond, Neolithic Studies Group Seminar Papers* **5**, Oxford, Oxbow Books.

Fenton, A. 1995 *The island blackhouse and a guide to 'The blackhouse' No 42 Arnol,* Edinburgh, Historic Scotland.

Fenton, A. 1997 *The Northern Isles: Orkney and Shetland.* East Linton, Tuckwell Press (reprint of 1978 edition).

Fenton, A. 1999 *Scottish Country Life*, East Linton, Tuckwell Press (reprint of 1976 edition).

Fergusson, D.C.L. 1878 'On the Norwegian origin of Scottish Brochs', *Proceedings of the Society of Antiquaries of Scotland* **12**, 630 – 669.

Fieller, N.R.J., Gilbertson, D.D. and Ralph N.G.A (eds) 1985 *Palaeoenvironmental Investigations: Research Design, Methods and Data Analysis, Symposium number 5(ii) of the Association for Environmental Archaeology.* BAR International Series **258.** Oxford, British Archaeological Reports.

Fitter, R. 1973 *Book of British Birds*, London, Drive Publications for the Reader's Digest and the Automobile Association.

Fitzpatrick, E.A. 1980 *Soils: their formation, classification and distribution*, London Longman.

Fojut, N. 1986 *A guide to Prehistoric and Viking Shetland.* Lerwick, Shetland Times Ltd.

Fojut, N. 1998 'How did we end up here? Shetland Iron Age Studies to 1995' in Nicholson and Dockrill, 1 - 48.

Foster, S.M. 1990 'Pins, combs and the chronology of later Atlantic Iron Age settlement' in Armit, 143-174.

Gautier, A. 1987 'Taphonomic groups: how and why?' *Archaeozoologia* **I**, 47-52.

Geist, V. 1971 *Mountain Sheep: A study in behavior and ecology.* Chicago, The University of Chicago Press.

Gilbertson, D., Kent, M. and Grattan, J. (eds) 1996 *The Outer Hebrides: The Last 14,000 years.* Sheffield Environment and Archaeological Research Campaign in the Hebrides 2, Sheffield, Sheffield Academic Press.

Graham-Campbell, J. and Batey, C.E. 1998 *Vikings In Scotland: An archaeological survey.* Edinburgh, Edinburgh University Press.

Grant, A. 1982 'The use of toothwear as a guide to the age of domestic ungulates', in Wilson, Grigson and Payne, 91-108.

Grayson, D.K. 1973 'On the methodology of faunal analysis', *American Antiquity* **39**, 432-439.

Grayson, D.K. 1979 'On The Quantification of Vertebrate Archaeofaunas', in Schiffer, 199 – 237.

Gribble, C.D. 1991 'The geology of the Outer Hebrides', in Pankhurst and. Mullin, 14-18.

Grigson, C. and Clutton-Brock, J. (eds) 1983 *Animals and Archaeology 2, Shell middens, fishes, and birds,* Oxford, British Archaeological Reports International Series **183**.

Halstead, P. 1985 'A study of mandibular teeth from Romano-British contexts at Maxey,' in F. Pryor and C. French *Archaeology and environment in the Lower Welland Valley, 1.* Norwich, East Anglian Archaeology 27, 219-224

Halstead, P. 1987 'Man and other animals in later Greek prehistory', *The Annual of the British School of Archaeology at Athens* **82,** 71-83.

Hamilton, G. 1987 *The Organic Garden Book*, London, Dorling Kindersley.

Hammond, N. (Ed.) 1983 *RSPB nature reserves,* Sandy, Beds. RSPB.

Harding, D.W, 1990 'Changing Perspectives in the Atlantic Iron Age', in Armit, 5-16.

Harding D.W. and Armit, I. 1990 'Survey and Excavation in West Lewis', in Armit, 71 – 107.

Harding, D.W. and Dixon, T.N. 2000 *Dun Bharabhat, Cnip, An Iron Age settlement in West Lewis, Volume 1 – The structures and material culture.* Edinburgh, Dept of Archaeology, University of Edinburgh.

Harding, D.W. and Gilmour, S. 2000 *The Iron Age settlement of Beirgh, Riof, Isle of Lewis, Excavations 1985-95.* Edinburgh, Dept of Archaeology, University of Edinburgh.

Harding, D.W. 2000 The Hebridean Iron Age: Twenty Years' Research, University of Edinburgh, Department of Archaeology, Occasional Papers Series No 20. http://www.arcl.ed.ac.uk/arch/publications/hebrides/index.html

Hedges, J. 1985 'The Broch Period' in Renfrew, 150-175.

Hedges, J.W. 1987 *Bu, Gurness and the brochs of Orkney*, Volumes *1 to 3.* BAR British Series **162 – 164**. Oxford, British Archaeological Reports.

Henry, D. (Ed.) 1997 *The worm, the germ and the thorn, Pictish and related studies presented to Isabel Henderson,* Balneaves, Angus, The Pinkfoot Press.

Henshall, A. 1985 'The Chambered Cairns', in Renfrew, 83-117.

Hesse, B. and Waspnish, P. 1985 *Animal bone archaeology*, Washington, Taraxacum Press.

Higgs, E.S. (Ed.) 1972 *Papers in Economic Prehistory*, Cambridge, Cambridge University Press.

Hill, J.D., 1995 *Ritual and Rubbish in the Iron Age of Wessex. A study on the formation of a specific archaeological record,* BAR British Series **242**, Oxford, British Archaeological Reports.

Hillson, S.W. 1985 'Missing information and collections of skeletal material', in Fieller, Gilbertson and Ralph, 137 – 146.

Hillson, S., 1986 *Teeth,* Cambridge, Cambridge University Press.

Historic Scotland n.d. 'Radiocarbon dating procedure 1996-9', Policy Document, Historic Scotland.

Hockett, B.S. 1996 'Corroded thinned and polished bones created by Golden Eagles (*Aquilla chrysaetos*): Taphonomic implications for archaeological interpretations', *Journal of Archaeological Science*, **23**, 587-591.

Hudson, G. 1991 'Geomorphology and soils of the Outer Hebrides', in Pankhurst and Mullin 19-27.

Humphrys, J. 2001 *The great food gamble,* London, Hodder and Stoughton.

Hunter, J.R. 1986 *Rescue excavations on the Brough of Birsay 1974 – 82*, Edinburgh, Society of Antiquaries of Scotland Monograph Series 4.

Hunter, J.R. 1990 'Pool, Sanday: a Case Study for the Late Iron Age and Viking Periods' in Armit (Ed.), 175 - 193.

Hunter, J.R. 1997 'The early Norse period', in Edwards and Ralston, 241 – 254.

Hunter, J.R., Bond, J.M., and Smith, A.N. 1995 'Some aspects of Early Viking Settlement in Orkney', in C.E Batey, E.J., Jesch, and C.D. Morris, (eds.), 272 – 284.

Hunter, J.R., Bond, J.M. and Smith, A.N. forthcoming *Archaeological Investigations in Sanday, Orkney: Volume 1: Pool,* Society of Antiquaries of Scotland Monograph Series.

Ingold, T. 1980 *Hunters, pastoralists and ranchers: reindeer economies and their transformations.* Cambridge, Cambridge University Press.

Ingold, T. 1994 'From trust to domination: an alternative history of human-animal relations', in Manning and Serpell, 1 – 22.

Ioannidou, E. 2003 'Taphonomy of Animal Bones: Species, Sex, Age and Breed Variability of Sheep, Cattle and Pig Bone Density', *Journal of Archaeological Science* **30**, 355 – 365.

Jarman, M.R, 1972 "European deer economies and the advent of the Neolithic" in Higgs (Ed.), 125 – 47.

Jenkinson, R.D.S and Gilbertson, D.D. 1984 *In the shadow of extinction.* Sheffield, Dept of Prehistory and Archaeology, University of Sheffield.

Jones, G. 1986 *The Norse Atlantic Saga: Being the Norse voyages of discovery and settlement to Iceland, Greenland and North America.* Oxford, Oxford University Press.

Kaland, S.H.H. 1995 'The settlement of Westness, Rousay', in C.E Batey, E.J. Jesch, and C.D. Morris, (eds.), 308 – 317.

Kelly, F. 1997 *Early Irish Farming: a study based mainly on the law-texts of the 7th and 8th centuries AD*, Dublin, Dublin Institute for Advanced Studies.

Kiedorf, U. and Becher, J. 1997 'Mineralisation and wear of mandibular first molars in red deer (*Cervus elaphus*) of known age', *Journal of Zoology,* London **241,** 135 – 143.

Knight, J.A. 1985 *Differential preservation of calcined bone at the Hirundo Site, Alton, Maine*, Unpublished M.Sc. thesis, Quaternary Science, University of Maine at Orono, cited in Lyman 1994.

Knowlton, D. 1977 *The Naturalist in The Hebrides*, London, David and Charles.

Legge, A.J and Rowley-Conwy, P.A. 1988 *Star Carr Revisited: A re-analysis of the large mammals.* London, Birkbeck College, University of London.

Legge, A.J. 1992 *Excavations at Grimes Graves, Norfolk, 1972 – 1976. Fascicule 4, Animals, environment and the Bronze Age economy,* London, British Museum Press.

Lieberman, D.E and Meadow, R. H. 1992 'The biology of cementum increments (with an archaeological application)', *Mammal Review* **22**, 57 – 77.

Lowe, V.P.W. 1967 'Teeth as indicators of age with special reference to Red deer (*Cervus elaphus*) of known age from Rhum', *Journal of Zoology*, London, **152**, 137 – 153.

Lockley, R.M. 1966 *Grey seal, common seal: an account of the life histories of British seals.* London, White Lion.

Lyman, R. L. 1994 *Vertebrate Taphonomy,* Cambridge Manuals in Archaeology, Cambridge, Cambridge University Press.

McCormick, F. 1992 'Early faunal evidence for dairying', *Oxford Journal of Archaeology* **11**, 201 – 209.

McCormick, F. 1998 'Calf slaughter as a response to marginality', in Mills and Coles, 49 – 52.

McCormick, F. (forthcoming) 'The mammal bones from Cnip wheelhouse, Lewis', Unpublished report for Historic Scotland/AOC.

McCormick, F. n.d. 'Faunal change in Scotland', unpublished manuscript.

McGovern, T.H. 1992 'Bones, buildings and boundaries: palaeoeconomic approaches to Norse Greenland', in Morris and Rackham, 193 – 230.

MacKie, E.W. 1965 'The origin and development of the Broch and Wheelhouse Building Cultures of the Scottish Iron Age', *Proceedings of the Prehistoric Society* **31**, 93 – 146.

MacKie, E.W. 1975 *Scotland: An Archaeological Guide*, London, Faber and Faber.

Mainland, I.L. 1998 'Dental microwear and diet in domestic sheep (*Ovis aries*) and goats (*Capra hircus*) distinguishing grazing and fodder-fed ovicaprids using a quantitative analytical approach', *Journal of Archaeological Science* **25**, 1259 – 1271.

Mainland, I.L. 2000 'A dental microwear study of seaweed eating and grazing sheep from Orkney', *International Journal of Osteoarchaeology* **10**, 93 – 107.

Maltby, M. 1979 *Faunal studies on urban sites: the animal bones from Exeter 1971 – 1975*, Sheffield, Dept. of Prehistory and Archaeology, University of Sheffield.

Maltby, J.M. 1985 'Patterns in faunal assemblage variability', in Barker and Gamble,

Manning, A. and Serpell, J. (eds) 1994 *Animals and human society: changing perspectives.* London, Routledge.

Martin, H. 1998 'Analysis of dental cementum rings as an approach to Azilian hunting strategies', *Environmental Archaeology* **3**, 13 – 22.

Marwick, E.W. 1975 *The folklore of Orkney and Shetland*, London, Batsford.

Mather, A.S. and Ritchie, W. 1977 *The beaches of the Highlands and Islands of Scotland,* Aberdeen, Aberdeen University Department of Geography for the Countryside Commission for Scotland.

Meadow, R.H. 1980 'Animal bones: problems for the archaeologist together with some possible solutions', *Paleorient* **6**, 65 – 77.

Mills, C. and Coles, G. (eds) 1998 *Life on the edge: Human settlement and marginality.* Symposia of the Association for Environmental Archaeology **13**, Oxford, Oxbow Books,

Montgomery, J., Evans, J.A. and Neighbour, T. forthcoming 'Sr isotope evidence for population movement within the Hebridean Norse community of NW Scotland'.

Moran, N.C. and O'Connor T.P. 1992 'Bones that cats gnawed upon: a case study in bone modification', *Circaea* **9**, 27 – 34.

Moran, N.C. and O'Connor T.P. 1994 'Age attribution in domestic sheep by skeletal and dental maturation: a pilot study of available sources', *International Journal of Osteoarchaeology* **4**, 267 – 285.

Morris, C.D. (Ed.) 1989 *Birsay Bay project, Vol. 1, Coastal sites beside the Brough Road, Birsay, Orkney, excavations 1976 – 1982,* Durham, University of Durham Department of Archaeology no. 1.

Morris, C.D. 1995 'Birsay Bay Project, a Résumé', in C.E Batey, E.J. Jesch, and C.D. Morris (eds.) 285 – 307.

Morris, C.D. 1996 *The Birsay Bay project Volume 2, sites in Birsay village and on the Brough of Birsay, Orkney,* Durham, University of Durham, Dept. of Archaeology Monograph Series 2.

Morris, C.D. and Rackham, D.J. (Eds) 1992 *Norse and later settlement and subsistence in the North Atlantic,* Glasgow, University of Glasgow Department of Archaeology.

Muir, T., 1998 *The Mermaid Bride and other Orkney folk tales*, Kirkwall, The Orcadian Press.

Mulville, J. 1999 'The mammal bones', in Parker Pearson and Sharples, 234-273.

Murie, O.J. 1951 *The elk of North America*, Pennsylvania, Stackpole Co.

Nance, J.D. 1990 'Statistical sampling in archaeology' in Voorips, A., *Mathematics and information science in archaeology: A flexible framework, 135 – 163.* Bonn, Holos.

Neighbour, T. and Crawford, J. 2001 'Bernera: reconstructing a figure of eight house at Bosta', *Current Archaeology* **175**, 294 – 300.

Neighbour T. and Crawford J., nd "Late Iron Age Houses on Bostadh Beach:Replicating Life in the Pictish Period on the Isle of Lewis", http://www.arcl.ed.ac.uk/arch/cfa/tim/index.html

Neighbour, T. and Montgomery, J. forthcoming 'You are what you eat: skeletal clues to the impact of the Norse on the Western Isles', in MacLeod, M. (Ed.) *Gall Ghaidheil* (proceedings of the Gall Ghaidheil conference, Stornoway, May 2000).

Neighbour, T. 2001 'Excavation at Bostadh Beach, Great Bernera, Isle of Lewis, CFA report.

Nicholson, R. A. 1993 'A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology', *Journal of Archaeological Science* **20**, 411 – 428.

Nicholson, R. A. and Dockrill, S.J. (eds) 1998 *Old Scatness Broch, Shetland: Retrospect and Prospect.* Bradford, Dept of Archaeological Sciences, University of Bradford.

Noddle, B. 1977 'The animal bones from Buckquoy, Orkney', in A. Ritchie, 1977, 201 – 209.

Noddle, B. 1984 'Exact chronology of epiphyseal closure in domestic mammals of the past: an impossible proposition', *Circaea*, **2**, 21 -27.

Noddle, B. 1989 'Flesh on the bones', *Archaeozoologia*, **3**, 25 – 50.

O'Connor, T., 1984 *Selected groups of bones from Skeldergate and Walmgate. The Archaeology of York Volume 15/1.* London, Council for British Archaeology.

O'Connor, T.P. 1985 'On the presentation of results in environmental archaeology' in N.R.J. Fieller, D.D Gilbertson, and N.G.A. Ralph, 147 – 152.

O'Connor, T.P. 1988 *Bones from the General Accident Site, Tanner Row, The Archaeology of York 15/2.* London, Council for British Archaeology.

O'Connor, T.P. 1989 *Bones from Anglo-Scandinavian Levels at 16 – 22 Coppergate, Archaeology of York 15/3.* London, Council for British Archaeology.

O'Connor, T.P. 1991a *Bones from 46 – 54 Fishergate. The Archaeology of York 15/4.* London, Council for British Archaeology.

O'Connor, T.P. 1991b 'Science, evidential archaeology and the new scholasticism', *Scottish Archaeological Review* **8**, 1 – 7.

O'Connor, T.P. 1992 'Pets and pests in Roman and medieval Britain', *Mammal Review* **22**, 107 – 113.

O'Connor, T.P. 1998 'On the difficulty of detecting seasonal slaughtering of sheep', *Environmental Archaeology* **3**, 5 – 11.

O'Connor, T. 2000 *The archaeology of animal bone, Stroud*, Sutton Publishing.

O'Hare, G. 1988 *Soils, Vegetation, Ecosystems*, Conceptual Frameworks in Geography, Edinburgh, Oliver & Boyd.

Orton, C. 2000 *Sampling in archaeology*, Cambridge, Cambridge University Press.

O'Sullivan, T. 1997 *Catalogue of the hand-retrieved bird and small mammal remains from Bostadh Beach, Great Berneraigh, Lewis, AOC* (Scotland) Ltd report 1515.

Owen, N., Kent, M. and Dale, P. 1996 'The machair vegetation of the Outer Hebrides: A review', in D. Gilbertson, M. Kent and J. Grattan, 123 – 131.

Owen, O. 1999 *The Sea Road: A Viking voyage through Scotland.* Edinburgh, Cannongate.

Pálsson, H. and Edwards, P. 1982 *Orkneyinga Saga,* Harmondsworth, Penguin Books.

Pankhurst, R.J. and Mullin, J.M., (eds) 1991 *Flora of the Outer Hebrides*, London, The Natural History Museum.

Parker Pearson, M., and Sharples, N. with J. Mulville and H. Smith 1999 *Between Land and Sea: Excavations at Dun Vulan, South Uist,* Sheffield, Sheffield Academic Press

Parker Pearson, M. and Sharples, N. 1999 'South Uist in the Iron Age', in Parker Pearson and Sharples with Mulville and Smith, 1 – 29.

Payne, S. 1972 'Partial Recovery and Sample Bias: The Results of Some Sieving Experiments', in E.S. Higgs (Ed.) *Papers in Economic Prehistory,* 49 –64. Cambridge, Cambridge University Press.

Payne, S. 1973 'Kill-off patterns in sheep and goats', *Anatolian Studies* **23**, 281-303.

Payne, S. 1975 'Partial recovery and sample bias' in A. T. Classon (Ed.) *Archaeozoological studies,* 7 – 17. New York, American Elsevier.

Payne, S. 1985a 'Morphological distinctions between the mandibular teeth of young sheep, (*Ovis aries*) and goats, (*Capra hircus*)', *Journal of Archaeological Science* **12,** 139-47.

Payne, S. 1985b 'Zooarchaeology in Greece: a reader's guide', in Wilkie and Coulson, (eds) 211-244.

Payne, S. 1987 'Reference codes for wear states in the mandibular cheek teeth of sheep and goats', *Journal of Archaeological Science* **14**, 609 – 614.

Payne, S. and Munson, P.J. 1985 'Ruby and how many squirrels? The destruction of bones by dogs', in N.R.J. Fieller, D.D Gilbertson, and N.G.A. Ralph, 31 – 48.

Pears, P. and Stickland, S. 1999 *The Royal Horticultural Society's Encyclopaedia of Practical Gardening: Organic Gardening.* London, Octopus.

Peterson, A. P. 2002 'Zoonomen nomenclature data', ***http:/www.zoonomen.net***

Piggott, S, 1966 'A scheme for the Scottish Iron Age' in A.L.F. Rivet (Ed.) *The Iron Age of Northern Britain, Edinburgh,* Edinburgh University Press, 1 - 15

Prebble, J. 1963 *The Highland Clearances*, London, Penguin.

Pryor, F. 1998 *Farmers in prehistoric Britain,* Stroud, Tempus.

Rackham, D.J. 1996 "Beachview, Birsay: The biological assemblage," in Morris 1996, 161-191

Ralston, I.B.M. 1997 'Pictish Homes,' in D. Henry, (Ed.) 18- 34.

Ralston, I.B.M and Armit, I. 1997 'The Early Historic Period: An Archaeological Perspective', in Edwards and Ralston, 217 – 240.

Ranwell 1974 *Sand dune machair: report of a seminar at Coastal Ecology Research Station, Norwich.* Norwich, Natural Environmental Research Council Institute of Terrestrial Ecology.

Red Deer Commission 1981 *Red Deer Management: A practical book for the management of wild red deer in Scotland.* Edinburgh, HMSO.

Reitz, E.J. and Cordier, D. 1983 'Use of allometry in zooarchaeological analysis' in Grigson and Clutton-Brock, 237 – 252.

Reitz, E. J., Quitmyer, I.R., Hale, H.S., Scudder, S.J. and Wing, E.S. 1987 'Application of Allometry to Zooarchaeology', *American Antiquity* **52**, 304 – 317.

Reitz, E. and Wing, E. 1999 *Zooarchaeology,* Cambridge Manuals in Archaeology, Cambridge, Cambridge University Press.

Renfrew, C (Ed.). 1985 *The Prehistory of Orkney,* Edinburgh, Edinburgh University Press.

Richards, M. 2000a 'Stable isotope analysis in archaeology: a short introduction', *The Archaeologist* **38,** 19 – 20.

Richards, M.P. 2000b 'Human consumption of plant foods in the British Neolithic: Direct evidence from bone stable isotopes' in A.S. Fairbairn, 123 – 135.

Ritchie, A. 1977 'Excavation of Pictish and Viking-age farmsteads at Buckquoy, Orkney' *Proceedings of the Society of Antiquaries of Scotland* **108**, 174 – 227.

Ritchie, A. 1985 'Orkney in the Pictish Kingdom', in Renfrew, 183 – 204.

Ritchie, A. 1994 *Perceptions of the Picts from Eumenius to John Buchan*, Rosemarkie, Groam House Museum Trust.

Ritchie, A. 1997 'The Picts in Shetland' in D. Henry, 35-46.

Ritchie, G. and A., 1981 *Scotland: Archaeology and early history*, London, Thames and Hudson.

Ritchie, W. 1966 'Sea level and coastal change in the Uists', Transactions of the Institute of British Geographers, **39**, 79 – 86.

Ritchie, W. 1976 'The meaning and definition of machair', *Transactions of the Botanical Society of Edinburgh* **42**, 431-440.

Ritchie, W. 1979 'Machair development and chronology in the Uists and adjacent islands' *Proceedings of the Royal Society of Edinburgh* **77B**, 107-122.

Ritchie, W. 1985 'Intertidal and sub-tidal organic deposits and sea level change in the Uists, Outer Hebrides' *Scottish Journal of Geology* **21**, 161-176.

Ritchie, W. 1991 'The geography of the Outer Hebrides' in Pankhurst, R.J and Mullin, J.M. 3 – 13.

Rose, D. 2001 'A dangerous liaison: an unholy alliance between the NFU and the Government means the countryside catastrophe goes on. Special report: foot and mouth disease', The Observer,*http:/www.observer.co.uk/*

Rowley-Conwy, P, Halstead, P. and Collins, P., 2002 'Derivation and Application of a Food Utility Index (FUI) for European Wild Boar (*Sus scrofa* L.)', *Environmental Archaeology* **7**, 77 – 87.

Ryder, M.L. 1983 *Sheep and Man*, London, Duckworth.

Salaman, R.N. 1985 *The history and social influence of the potato,* Revised edition, Cambridge, Cambridge University Press.

Schiffer, M.B. 1979 *Advances in archaeological method and theory* **2**. New York, Academic Press.

Schmid, E. 1972 *Atlas of Animal Bones*. London Elsevier,

Scott, L.W. 1947 'The Problem of the Brochs', *Proceedings of the Prehistoric Society* **13**, 1 – 36.

Serjeantson, D. 1988 'Archaeological and ethnographic evidence for seabird exploitation in Scotland', *Archaeozoologia* **2**, 209 – 288.

Serjeantson, D. 1990 'The Introduction of mammals to the Outer Hebrides and the role of boats in stock management', *Anthropozoologica* **13**, 7 – 18.

Serjeantson, D. 1998 'Birds: a seasonal resource', *Environmental Archaeology* **3**, 23 – 34.

Serjeantson, D. 2001 'The great auk and the gannet: a prehistoric perspective on the extinction of the great auk', *International Journal of Osteoarchaeology* **11**, 43 – 55.

Serjeantson, D. n.d. 'The mammal, bird and fish remains from Rosinish', Unpublished report from the Dept of Extra-Mural Studies, University of London.

Serpell, J.A. 2000 'Domestication and history of the cat', in Turner and Bateson, 179 –192.

Seton, G. 1980 *St Kilda,* facsimile of 1878 edition, Edinburgh, James Thin.

Sharples, N. 1998 *Scalloway: A Broch, Late Iron Age Settlement and Medieval Cemetery in Shetland.* Oxford, Oxbow.

Shaw Grant, J. 1987 *Discovering Lewis and Harris*, Edinburgh, John Donald.

Shepherd, A. 1994 'Howe – A review of the sequence' in Ballin Smith, 267 – 290.

Shipman, P., Foster, G.F. and Schoeninger, M. 1984 'Burnt bones and teeth: an experimental study of colour, morphology, crystal structure and shrinkage', *Journal of Archaeological Science* **11**, 307 – 325.

Shirreff, J. 1814 *General view of the Agriculture of the Orkney Islands with observations on the means of their improvement; drawn up for the consideration of the Board of Agriculture.* Edinburgh, Archibald Constable & Co.

Simpson, I.A., Dockrill, S.J. and Lancaster, S.J. 1998 'Making arable soils: anthropogenic soil formation in a multi-period landscape', in Nicholson and Dockrill, 111 – 126.

Silver, I. 1969 'The ageing of domestic animals', in Brothwell and Higgs, 283-302.

Smith, C., with Hodgson, G.W.I., Armitage, P., Clutton-Brock, J., Dickson, C. and Holden, T. 1994 'Animal bone report' in Ballin Smith, 139-153.

Stace, C. 1991 *New flora of the British Isles.* Cambridge, Cambridge University Press.

Stallibrass, S. 1982 'The use of cement layers for absolute ageing of mammalian teeth', in Wilson, Grigson and Payne, 109 – 26.

Stallibrass, S. 1990 'Canid Damage to Animal Bones: Two Current Lines of Research, in D.E. Robinson (Ed.) *Experimentation and Reconstruction in Environmental Archaeology*, 151 – 165. Symposia of the Association of Environmental Archaeology No. 9, Roskilde, Denmark. Oxford, Oxbow Books.

Statistical Account 1791 – 1799. Sir John Sinclair (Ed.) *The Statistical Account of Scotland 1791 – 1799.* Facsimile edition 1978, Wakefield, E.P. Publishing.

Tams, A. 2003 *Soil Micromorphology of Archaeological Deposits with particular reference to floor surfaces on settlement sites in the Western Isles, Scotland*, Unpublished PhD thesis, University of Edinburgh.

Taylor, R.E. 1987 Radiocarbon *Dating: An archaeological perspective*, London, Academic Press.

Tchernov, E. and Horwitz, L.K. 1991 'Body Size Diminution under Domestication: Unconscious selection in Primeval Domesticates', *Journal of Anthropological Archaeology* **10**, 54 – 73.

Thoms, J. 2002 'Bone', Cameron, 49.

Thoms, J. forthcoming a 'Dryburn Bridge: - a reappraisal of the animal bones', Report for C.F.A. Archaeology Ltd.

Thoms, J. forthcoming b 'The animal bone from Bruach an Druimein, Poltalloch. Excavations 1960 – 62', Report for G.U.A.R.D, Dept of Archaeology, Glasgow.

Thomson, W.P.L. 2001 *The new history of Orkney*. Edinburgh, Mercat Press

Tipping, R. 1994 'The form and fate of Scotland's woodlands', *Proceedings of the Society of Antiquaries of Scotland* **124**, 1-54.

Turner, D.C. 2000 'The human-cat relationship', in Turner and Bateson, 193 – 206.

Turner, D.C. and Bateson, P. (eds) 2000 The *Domestic Cat: The biology of its behaviour*, 2nd edition, Cambridge, Cambridge University Press.

Turner, D.C and Bateson, P. 2000 'Why the cat?' in Turner and Bateson, 3 – 6.

Vaurie, C. 1965 *The birds of the Palearctic fauna. A systematic reference: non-Passeriformes.* London, Witherby.

Wellander, R.D.E., Batey, C. and Cowie, T.G. 1987 'A Viking burial from Kneep, Uig, Isle of Lewis', *Proceedings of the Society of Antiquaries of Scotland* **116**, 149 – 174.

von Weymarn, J.A. 1979 'A new concept of glaciation in Lewis and Harris, Outer Hebrides', *Proceedings of the Royal Society of Edinburgh* **77B**, 97-105

Whittington, G. and Edwards, K. J. 1997 'Climate change', in Edwards and Ralston, 11 – 22.

Wilkie, N.C. and. Coulson, W.D.S (eds) 1985 *Contributions to Aegean archaeology: Studies in honour of William A. Macdonald*, 211-244, Dubuque, Iowa, Kendall/Hunt.

Wilkins, D.A. 1984 'The Flandrian woods of Lewis', *Journal of Ecology* **72**, 251-258.

Willis, D. 1991 *The story of crofting in Scotland,* Edinburgh, John Donald.

Wilson, B., Grigson, C. and Payne, S. 1982 *Ageing and Sexing of Animal Bones, BAR* British Series 109, Oxford, British Archaeological Reports.

Wilson, D.E. and Reeder, D.M. 1993 *Mammal species of the world: a taxonomic and geographic reference.* Washington and London, Smithsonian Institute Press.

Young, A. and Richardson, K.M. 1960 'A'Cheardach Mhor, Drimore, South Uist', *Proceedings of the Society of Antiquaries of Scotland* **93**, 135 – 173.

Young, A. 1962 'Brochs and Duns', *Proceedings of the Society of Antiquaries of Scotland* **95**, 171 – 198.

Figure 1.1 Location map for Bostadh

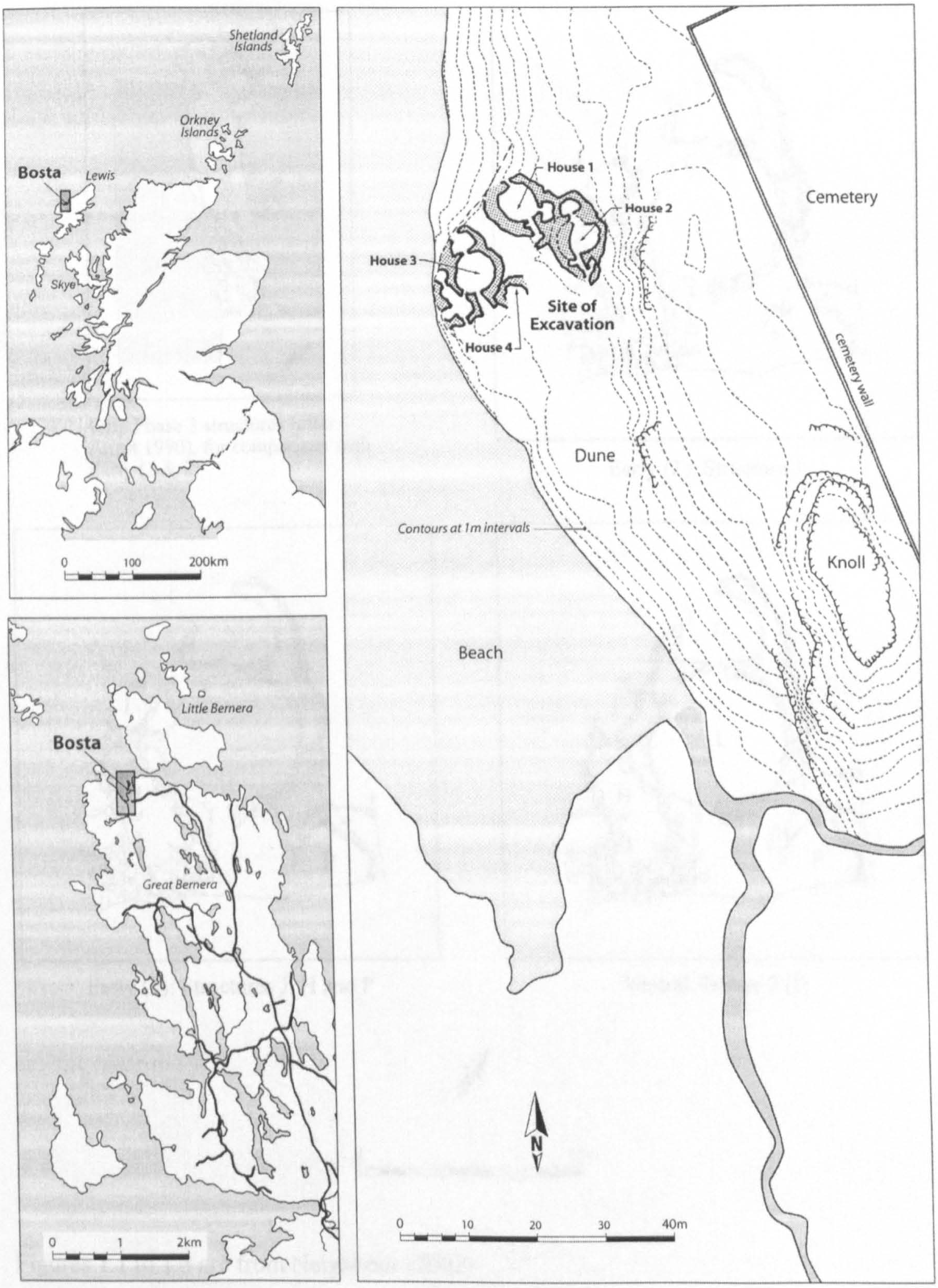
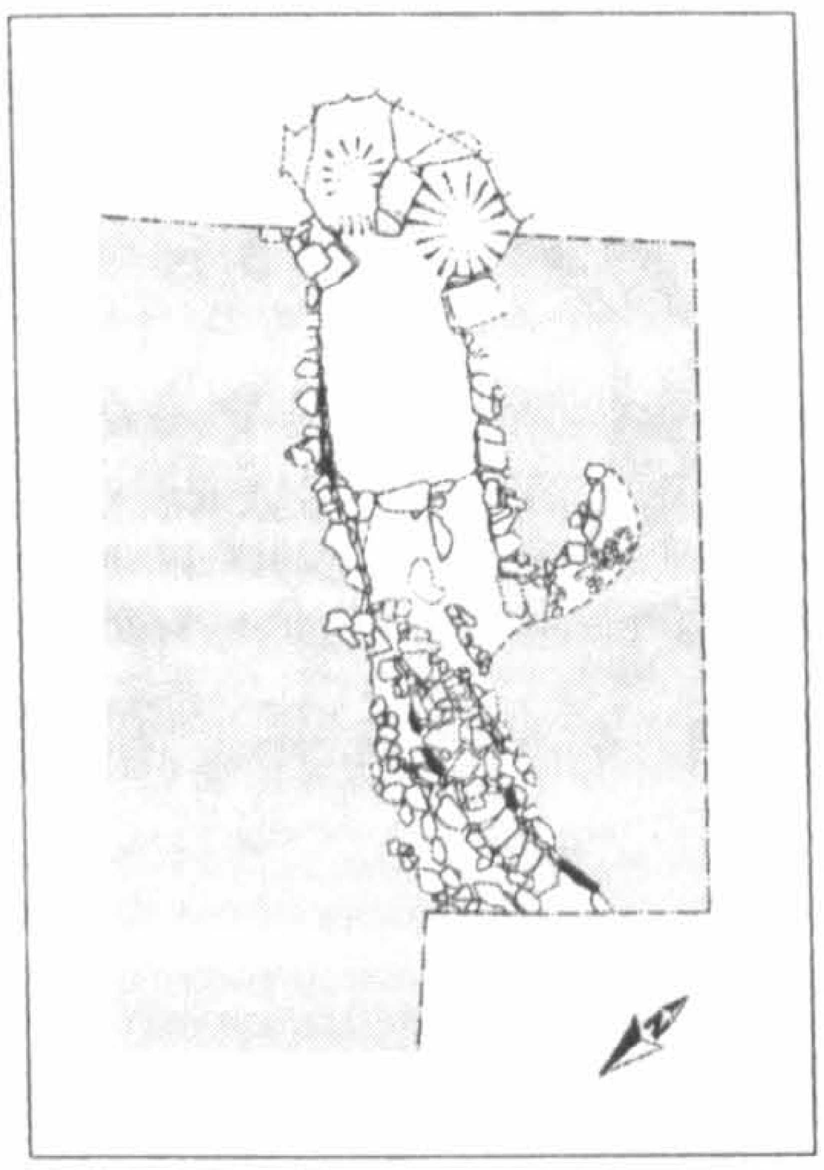
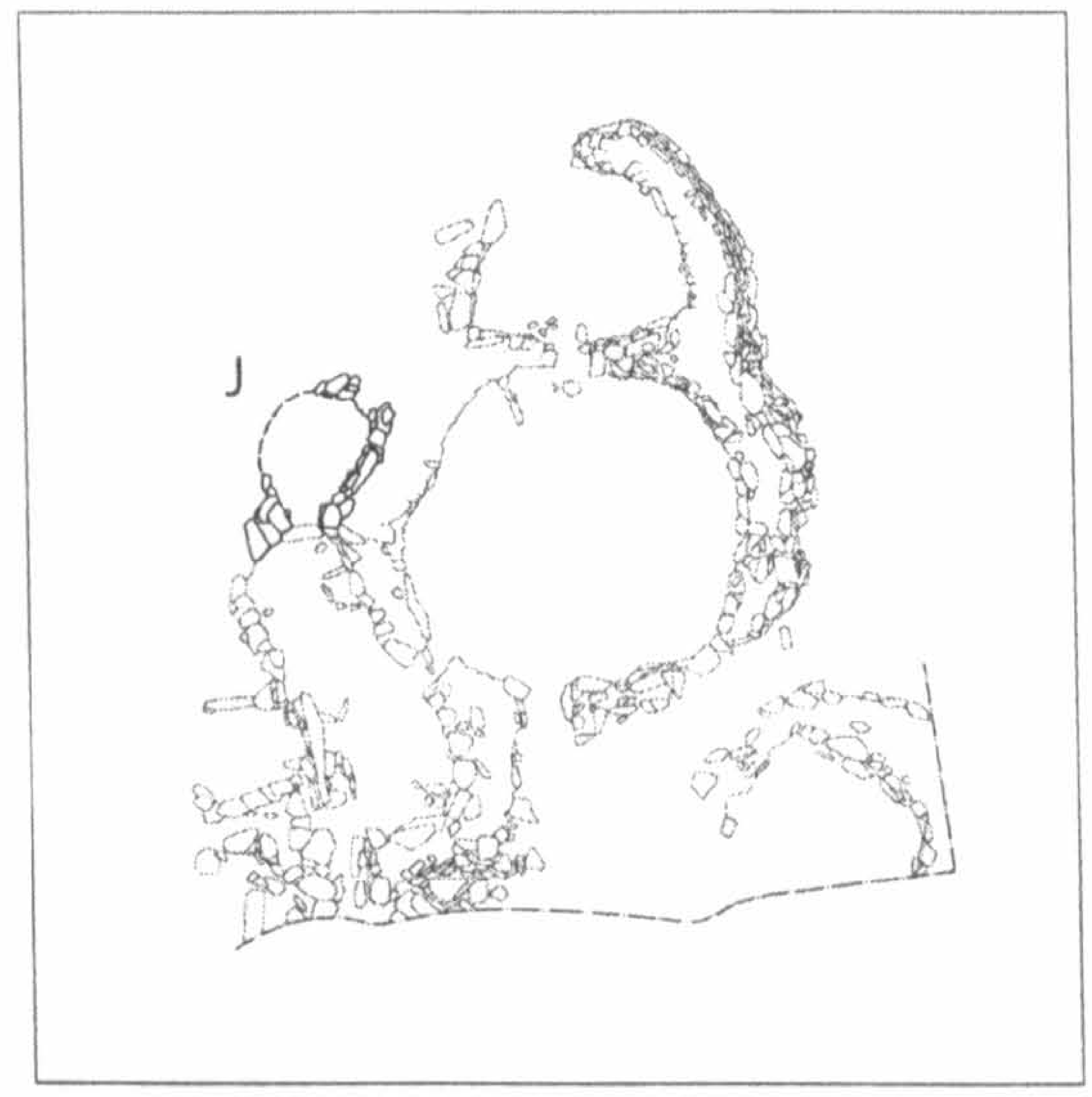


Figure 1.2 Structural sequence at Bostadh – earlier phases

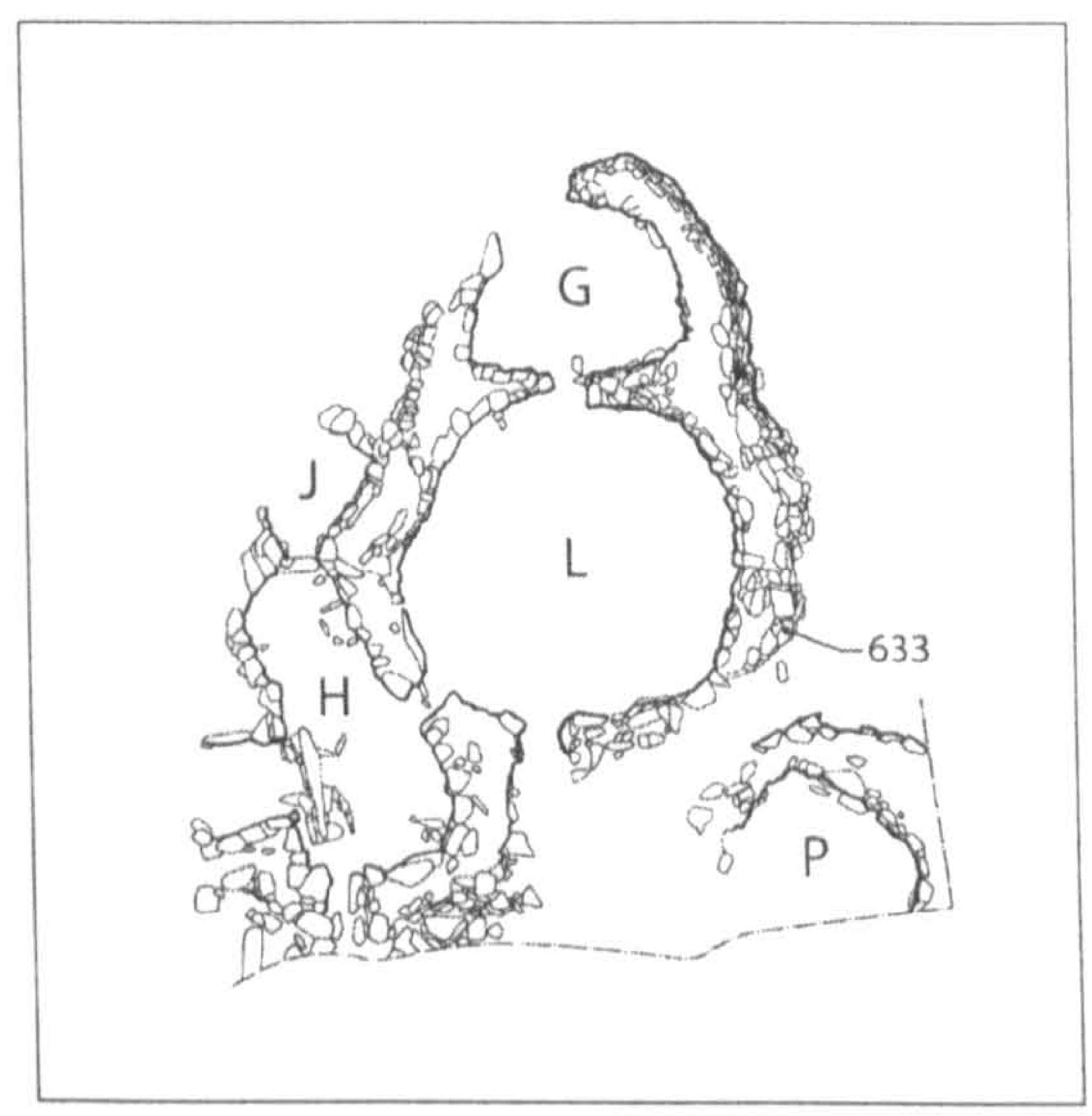


Cnip Phase 3 structures (after Armit 1990), for comparison with Early (1 & 2)

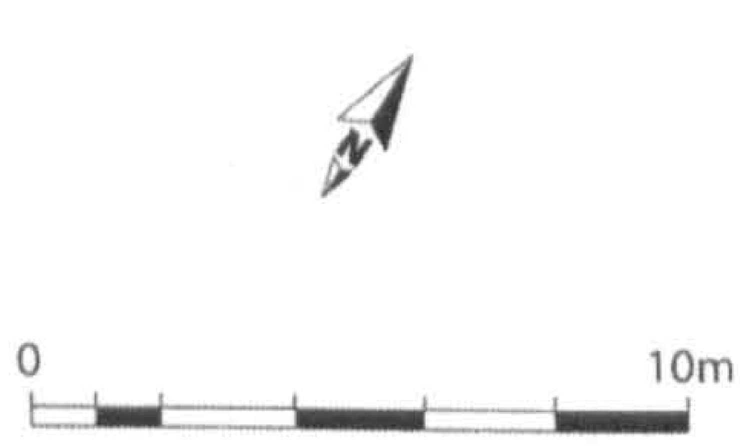


Early (1): Structure J

Early (2): Structures J, H and P

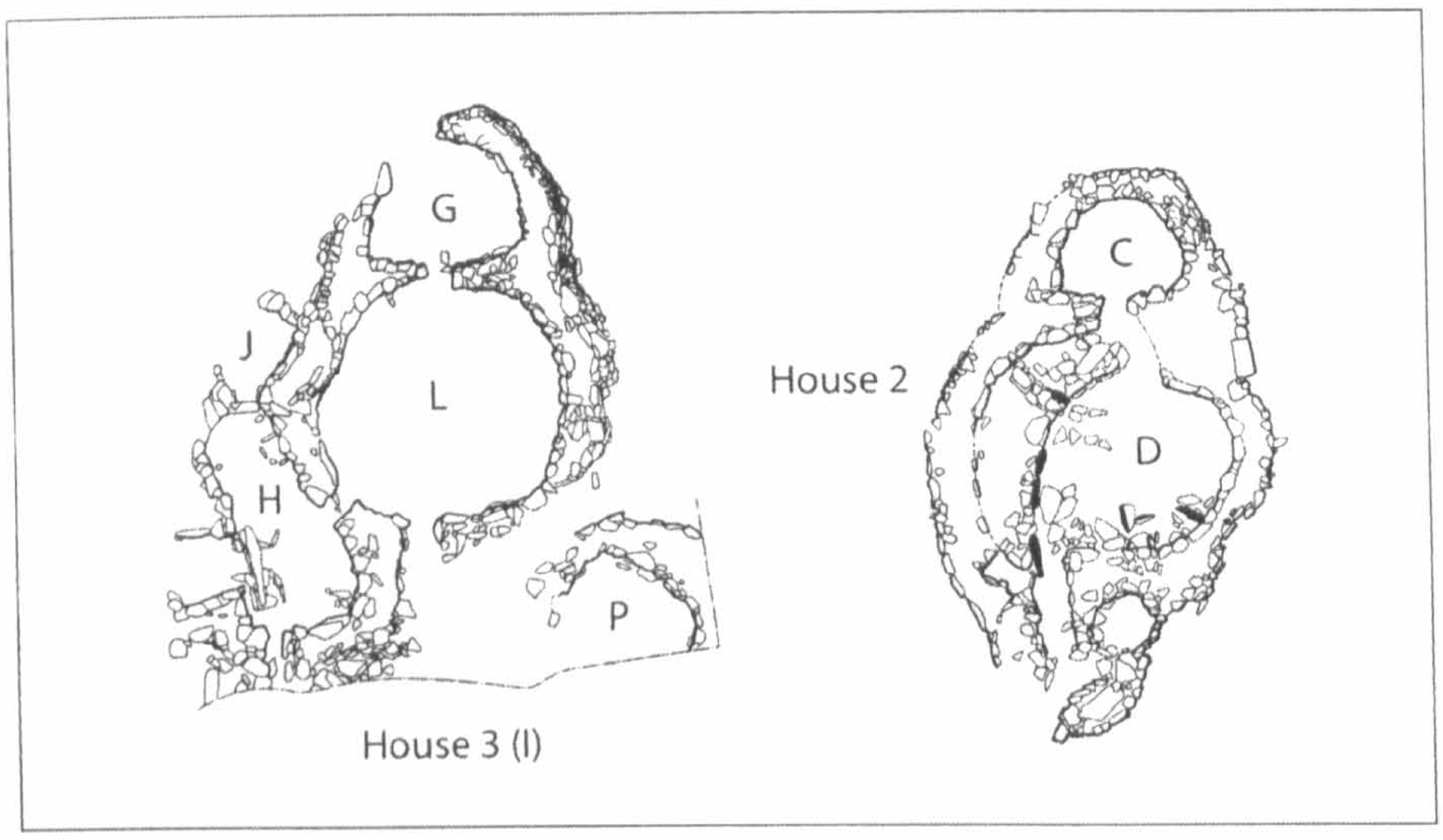


Ventral: House 3 (I)

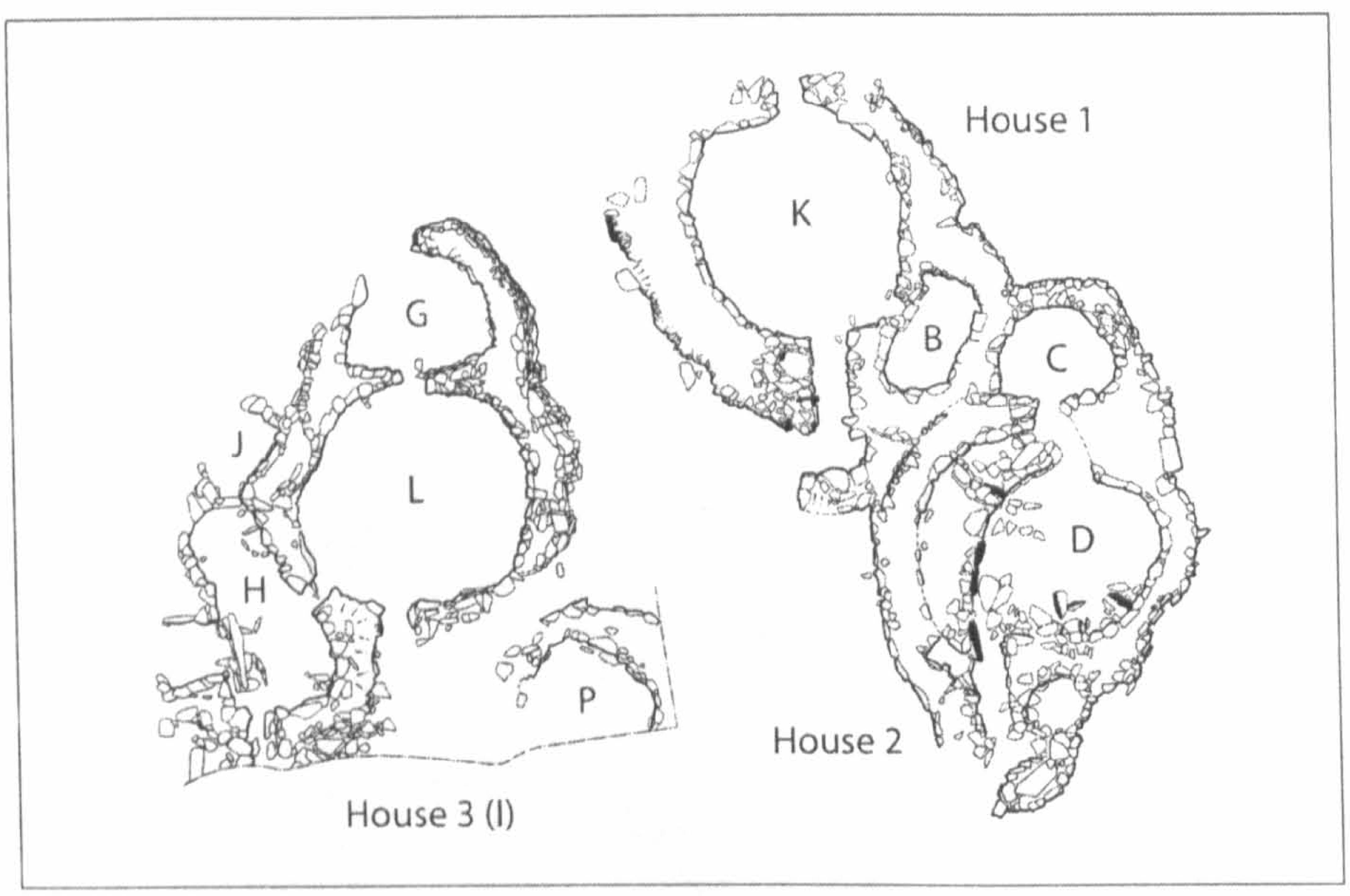


Figures 1.1 to 1.3 are from Neighbour (2001)

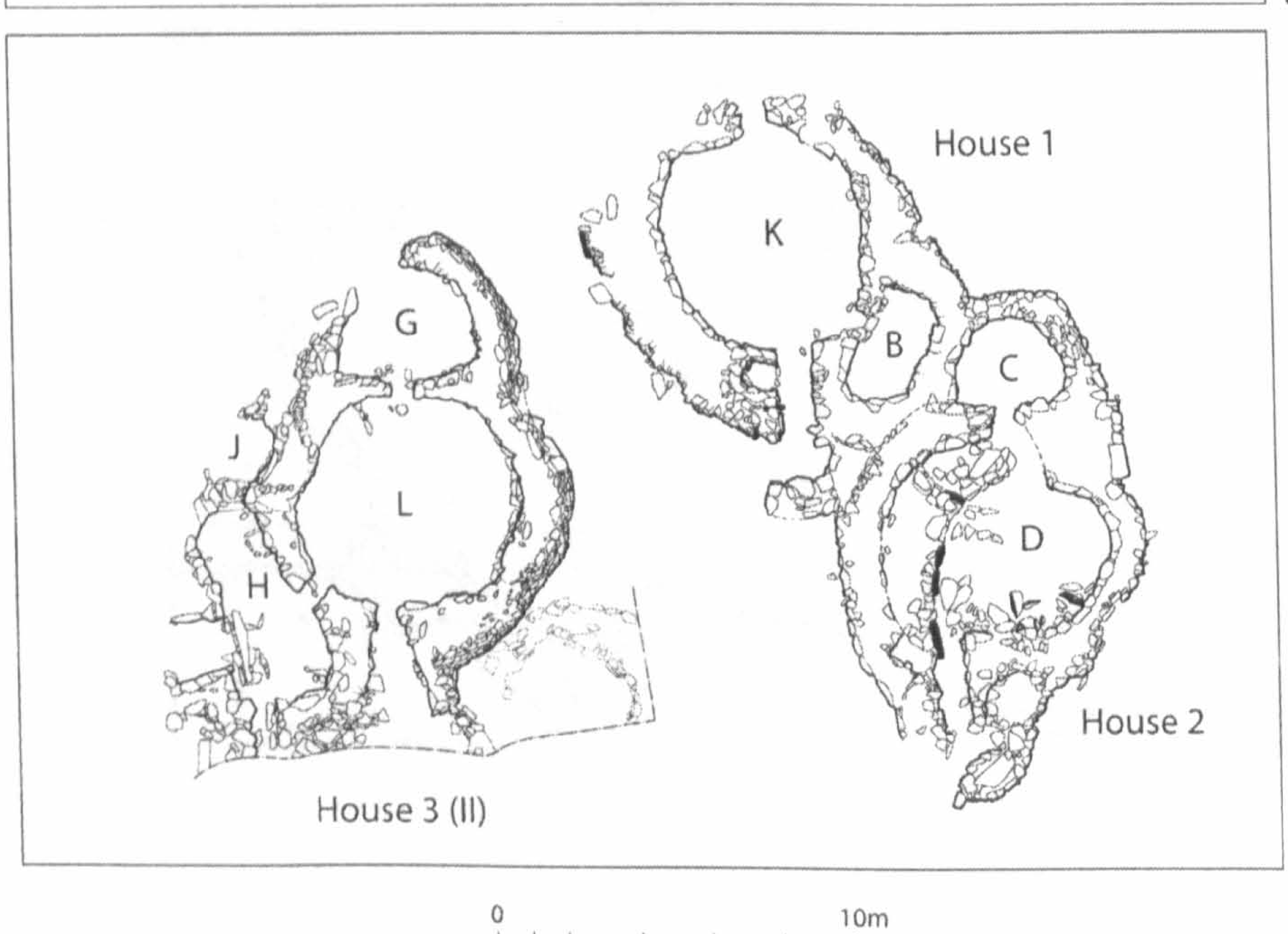
Figure 1.3 Structural phases at Bostadh – later phases



Ventral: House 3(I) and House 2



Ventral: House 3(I) and Houses 1 & 2



Ventral: House 3(II) and Houses 1 & 2

Figure 1.4 Location map – Bhaltos peninsula (Harding and Gilmour 2000, 2)

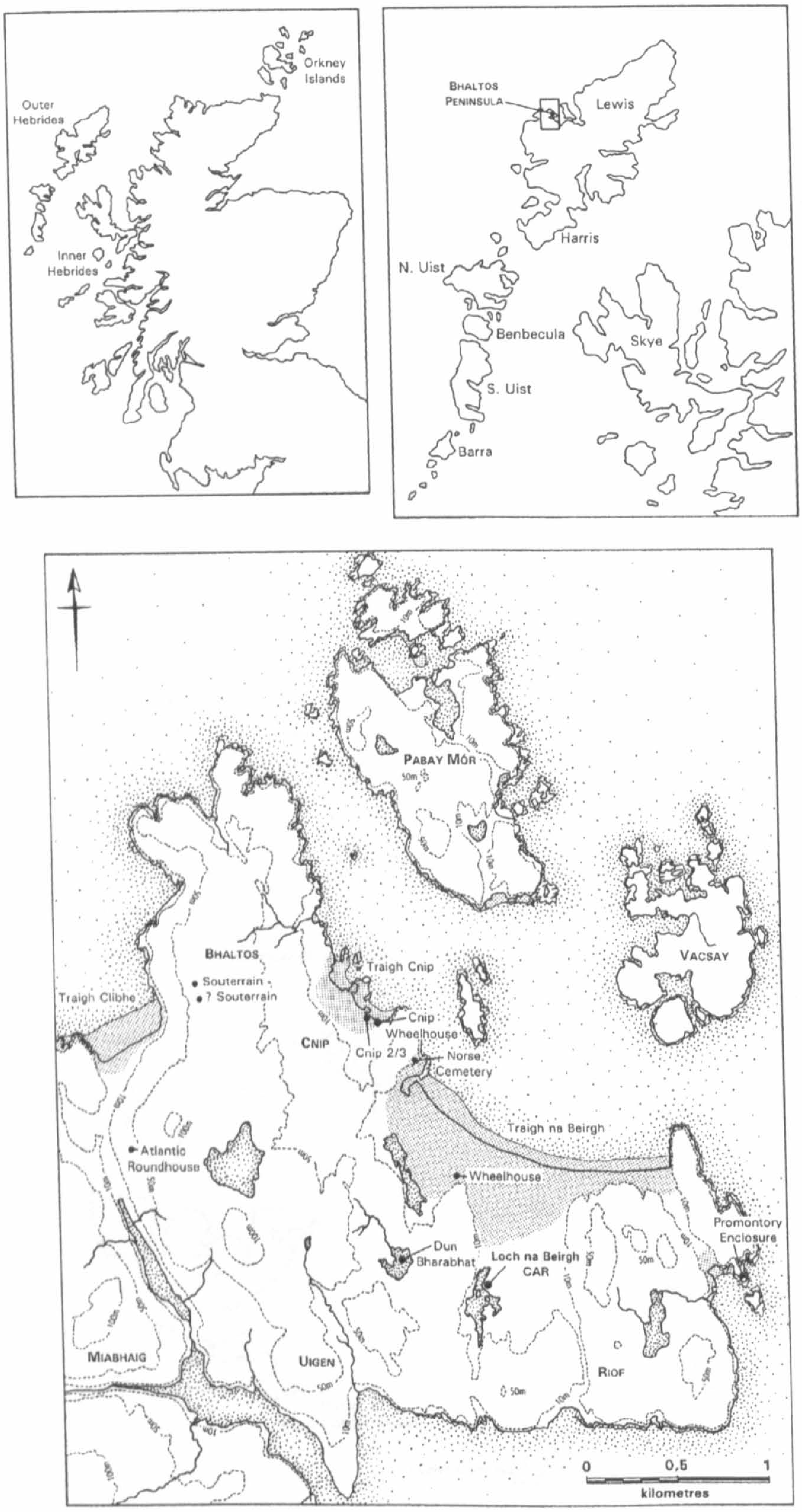


Figure 1.5 The structures at Beirgh: Phases 1 – 6 (Harding and Gilmour, 2000, 6)

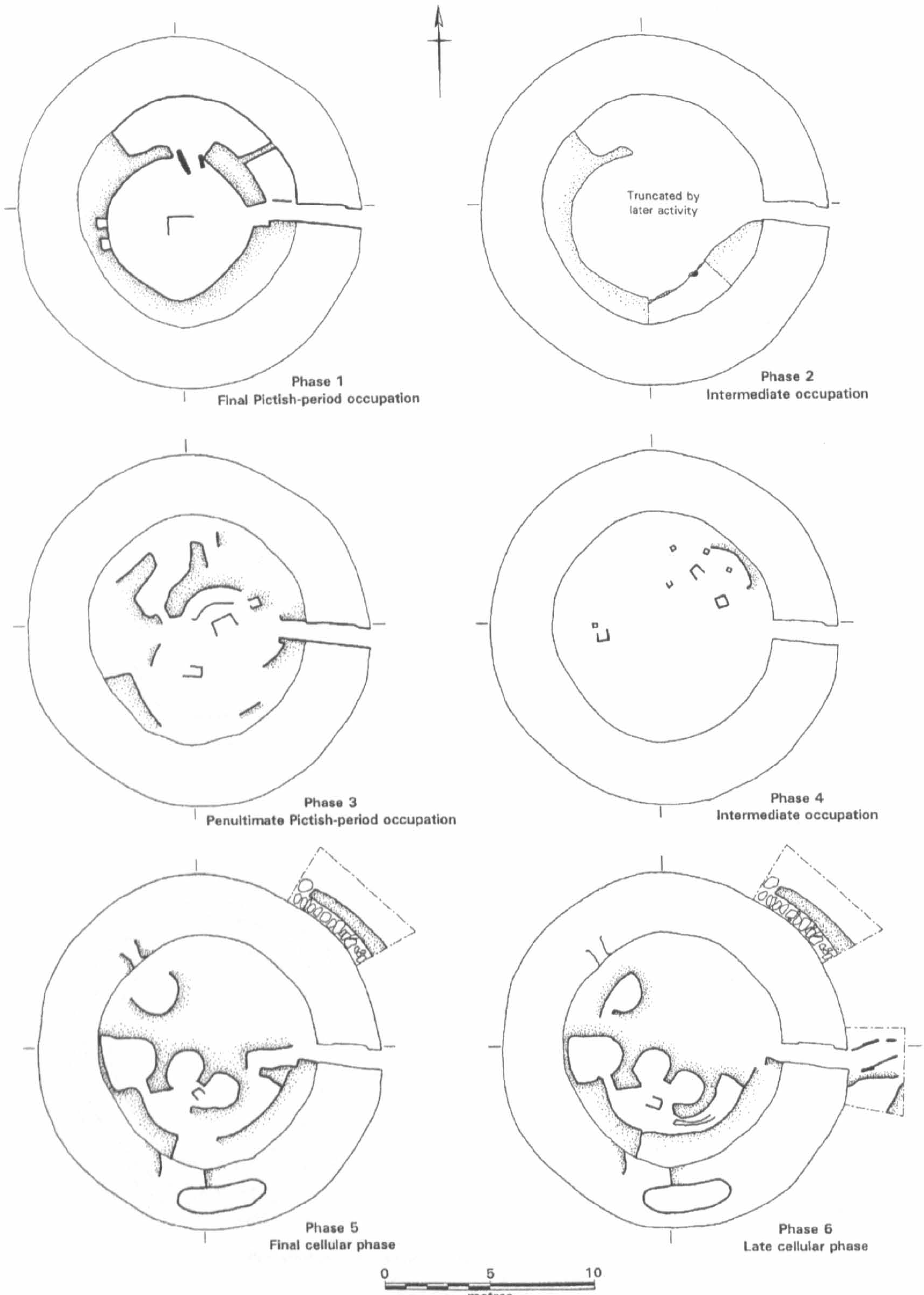


Figure 1.6 The structures at Beirgh: Phases 7 – 12 (Harding and Gilmour 2000, 7)

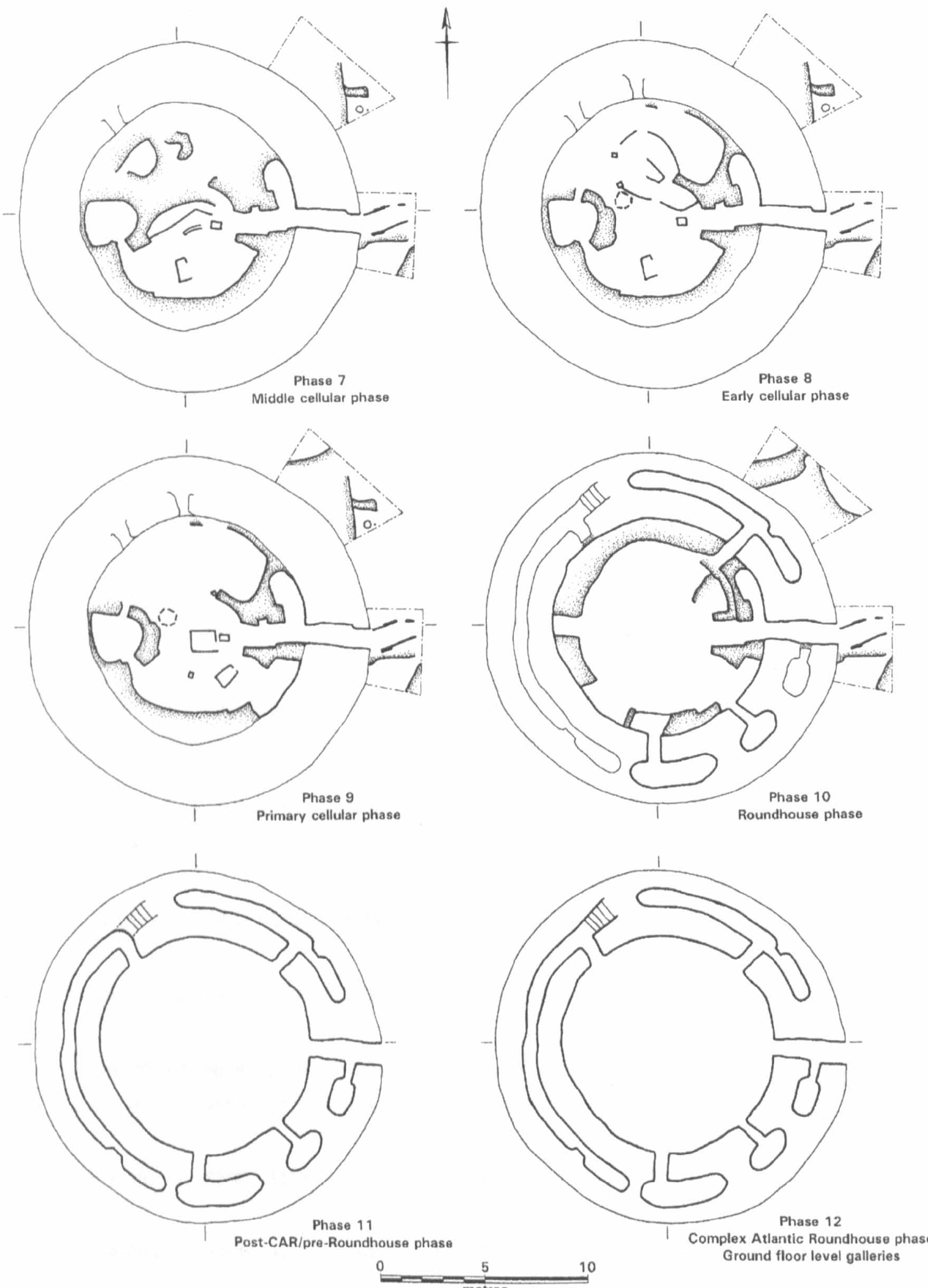


Figure 1.7: Bostadh Radiocarbon dates

(Scottish Universities Research and Reactor Centre)

East Kilbride, 11th January 2002

Context	Code	Code	14C age BP *(before 1950AD)*	Calibrated	Material
20A	A-A46085	GU-9643	1180 +/- 40BP	770AD-980AD	grain: Hordeum sp. caryopsis
20B	AA-46086	GU-9644	1125 =/- 45BP	780AD-1000AD	grain: Hordeum hulled caryopsis
53D	AA-46082	GU-9640	1200 =/- 45 BP	680AD-970AD	grain: Hordeum (hulled) sp.
53E	AA-46083	GU-9641	1100 =/- 45 BP	820AD-1030AD	grain: Hordeum (hulled) sp.
53F	AA-46084	GU-9642	1145 =/- 40 BP	770AD-990AD	grain: Hordeum (hulled) sp.
112A	AA-46080	GU-9638	1145 +/+ 45BP	770AD-990AD	grain: Hordeum (hulled symmetric) caryopsis
112C	AA-46081	GU-9639	1190 +/- 40BP	760AD-980AD	grain: Hordeum (hulled) sp.
148A	AA-46089	GU-9647	1205 +/- 45BP	910AD-960AD	grain: Hordeum hulled symmetric caryopsis
165/ 147	AA-46096	GU-9655	1270 +/- 45BP	660AD-880AD	grain: Hordeum hulled symmetric caryopsis
165/ 148	AA-46097	GU-9656	1275 +/- 40BP	660AD-870AD	grain: Hordeum caryopsis
33C	AA-46090	GU-9649	1150 +/- 40BP	770AD-990AD	grain: Hordeum (hulled) sp.
33D	AA-46091	GU-9650	1195 +/- 50BP	680AD-980AD	grain: Hordeum (hulled) sp.
234A	AA-46107	GU-9669	1150 +/- 40 BP	680AD-900AD	grain: Hordeum hulled caryopsis
248A	AA-46087	GU-9645	1160 +/- 45BP	770AD-990AD	grain: Hordeum hulled symmetric caryopsis
248C	AA-46088	GU-9646	1225 +/- 45BP	920AD-940AD	grain: Hordeum (hulled) sp.
714A	AA-46094	GU-9653	1195 +/- 45BP	690AD-980AD	grain: Hordeum (hulled symmetric) caryopsis
714B	AA-46095	GU-9654	1200 +/- 45BP	680AD-970AD	grain: Hordeum (hulled symmetric) caryopsis
315A	AA-46105	GU-9667	1185 +/- 40BP	760AD-980AD	grain: Hordeum (hulled symmetric) caryopsis
234A	AA-46107	GU-9669	1220 +/- 40BP	680AD-900AD	grain: Hordeum hulled caryopsis
362A	AA-46100	GU-9659	1220 +/- 45BP	920AD-950AD	grain: Hordeum hulled symmetric caryopsis
362B	AA-46101	GU-9660	1175+/- 45BP	770AD-980AD	grain: Hordeum hulled symmetric caryopsis
885/6 B	AA-46104	GU-9666	1215 +/- 40BP	920AD-940AD	grain: Hordeum hulled symmetric caryopsis

The dates are calibrated to 95% confidence levels (or 2 σ). There are two laboratory codes because the dates were processed in Glasgow and counted in Arizona, normal practice with Scottish radiocarbon dates at the time (Ian Ralston, pers com.).

Figure 1.8 Location map of Bhaltos peninsula and Great Bernera showing the sites mentioned in the text.

Copyright Digimap

(Darker yellow shows higher ground)

Figure 1.9: Plan of Beirgh, Complex Atlantic roundhouse phase (Phase 10) From Harding (2000).

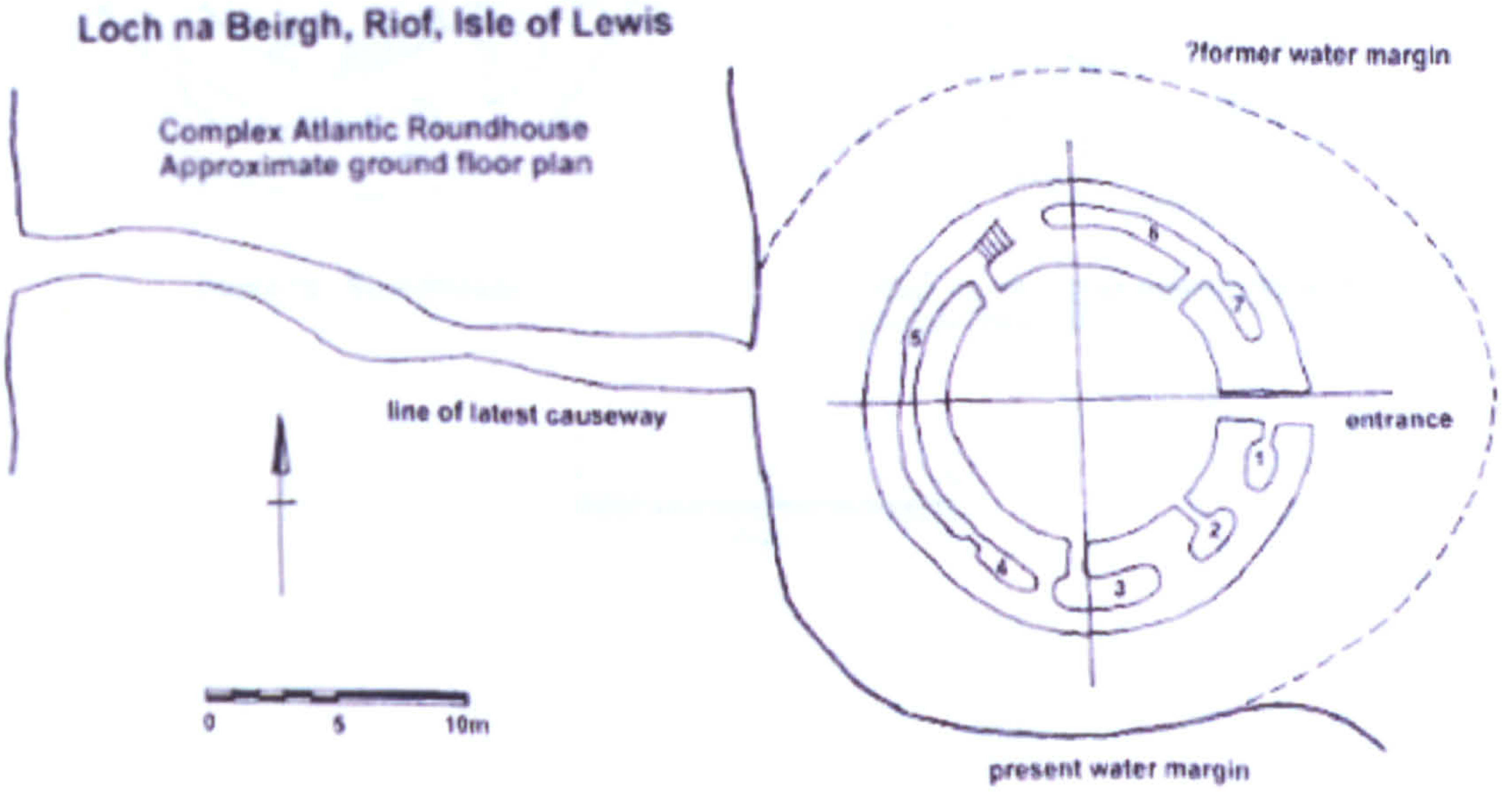


Figure 1.10: The main occupation phases at Beirgh (Harding 2000)

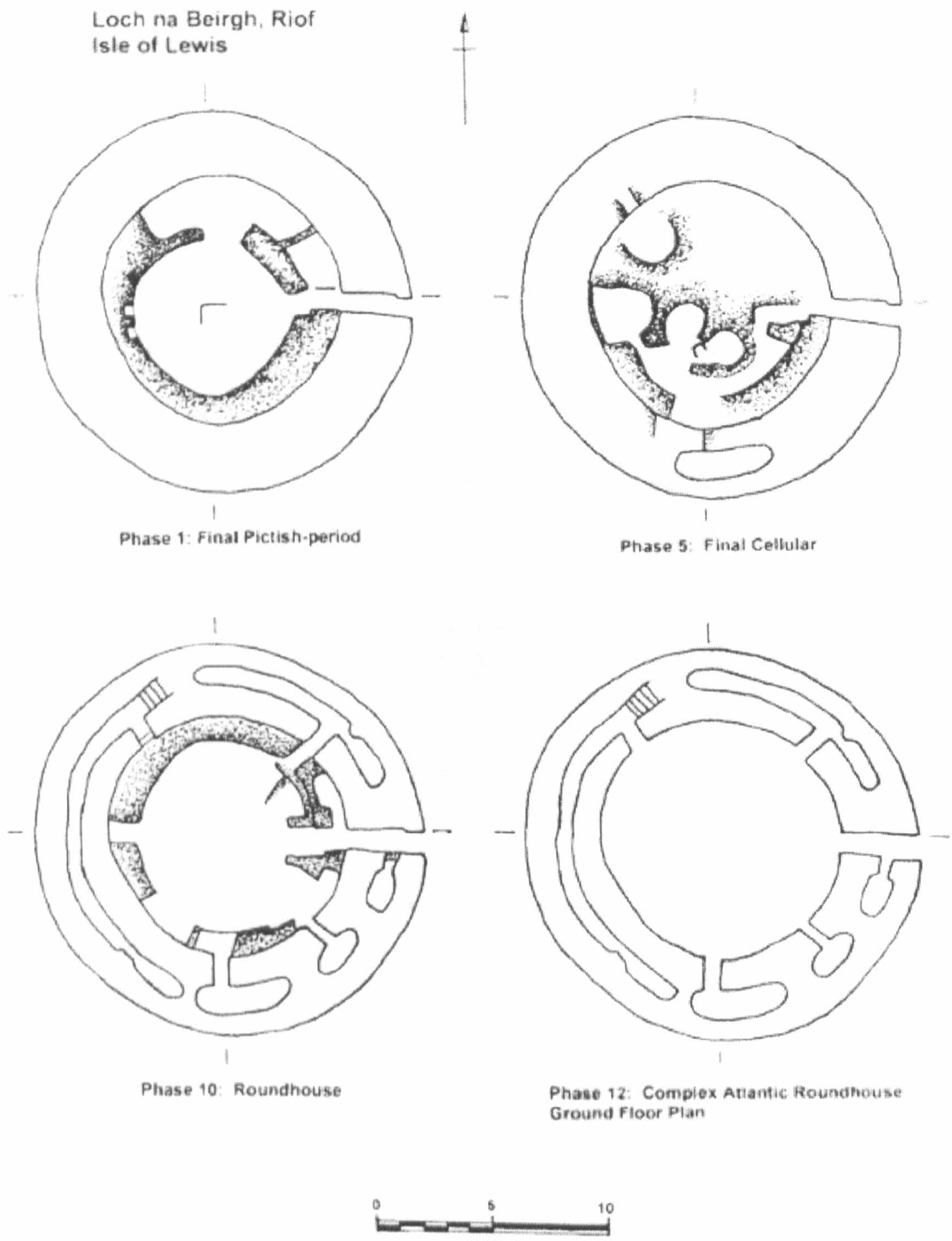


Figure 2.1: House 4, structure P
From Neighbour (2001)

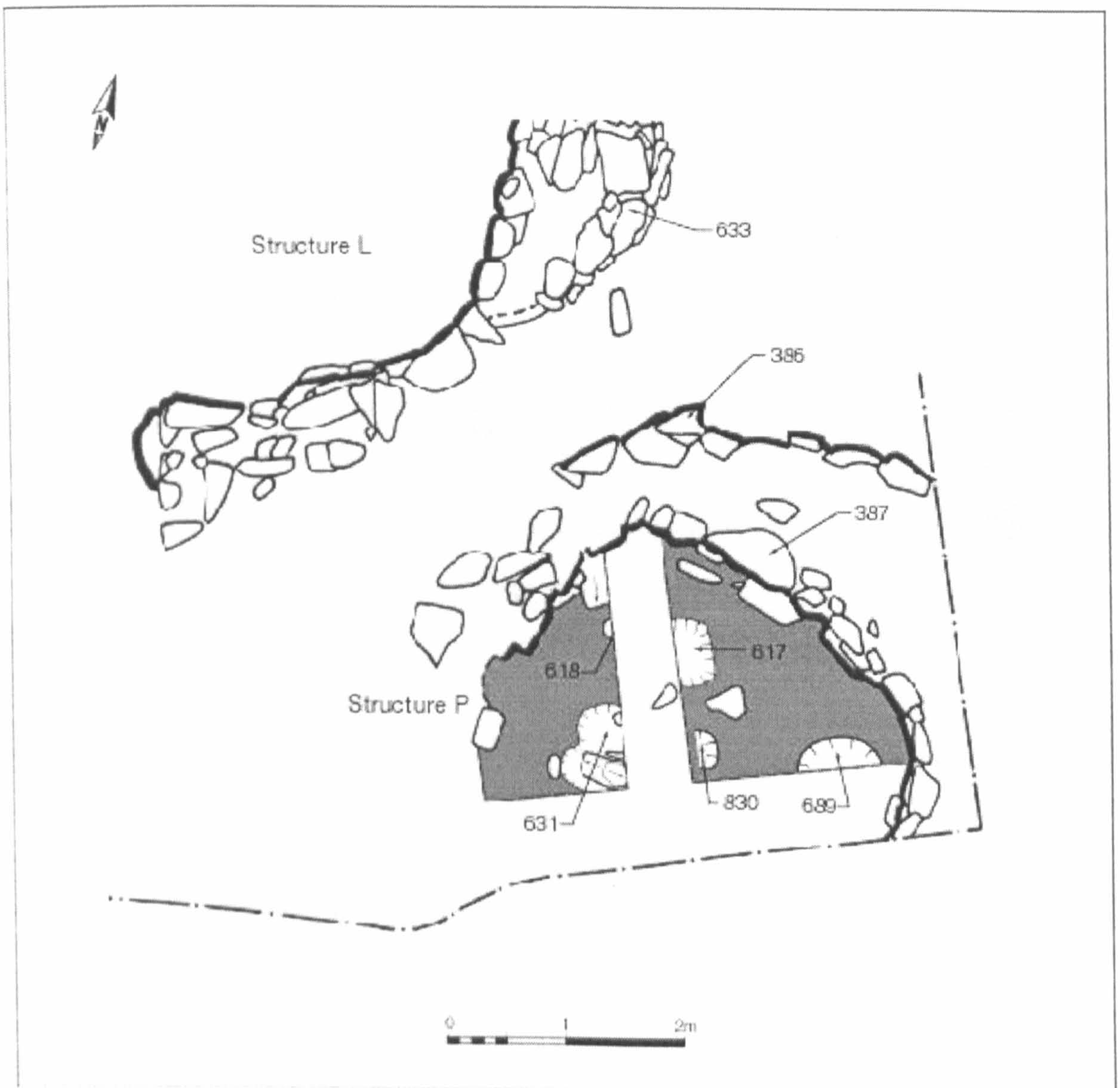


Figure 2.2: House 4, structure P: North to South section From Neighbour (2001)

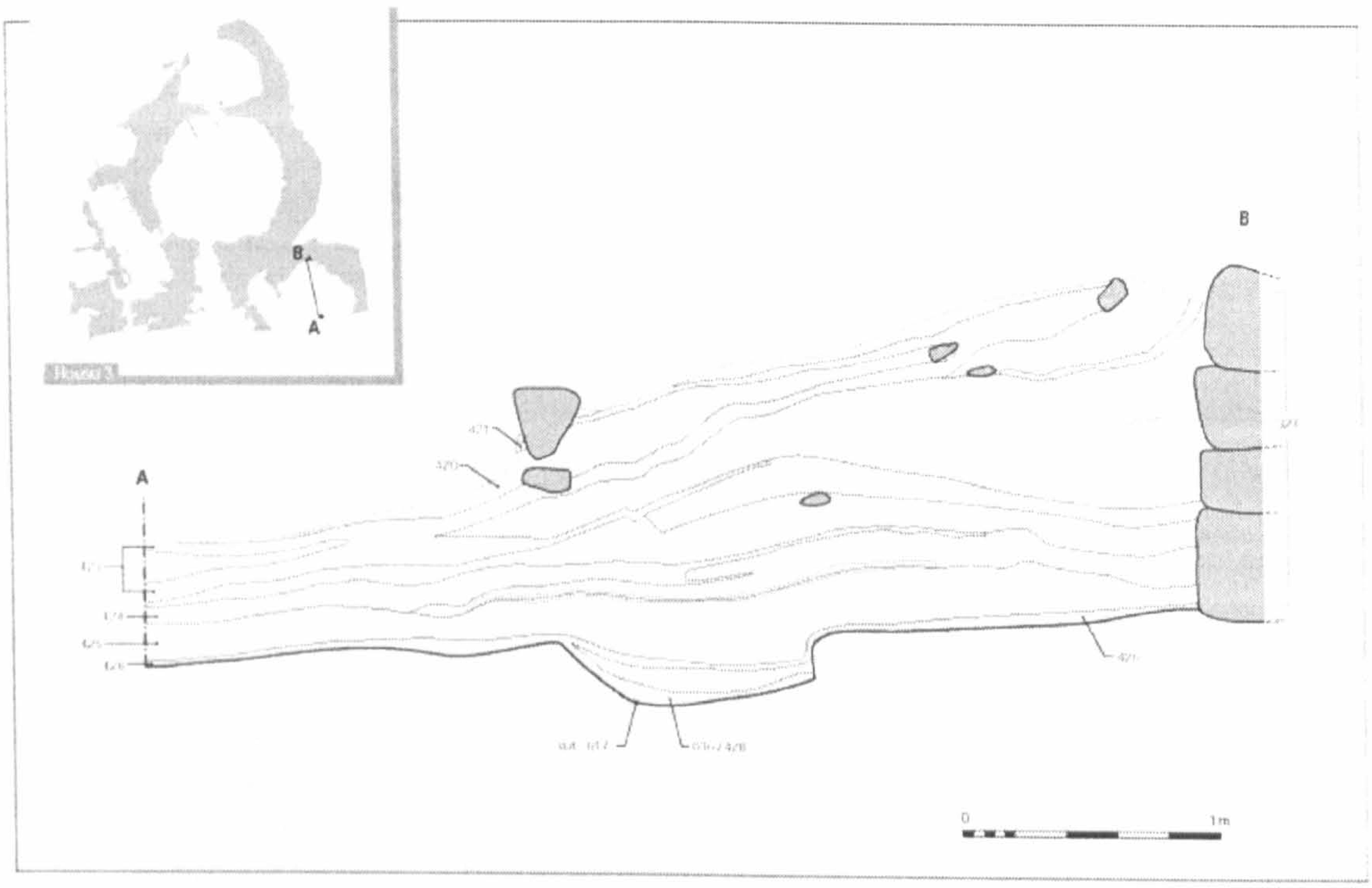


Figure 2.3: House 3, structure L: Occupation features
From Neighbour (2001)

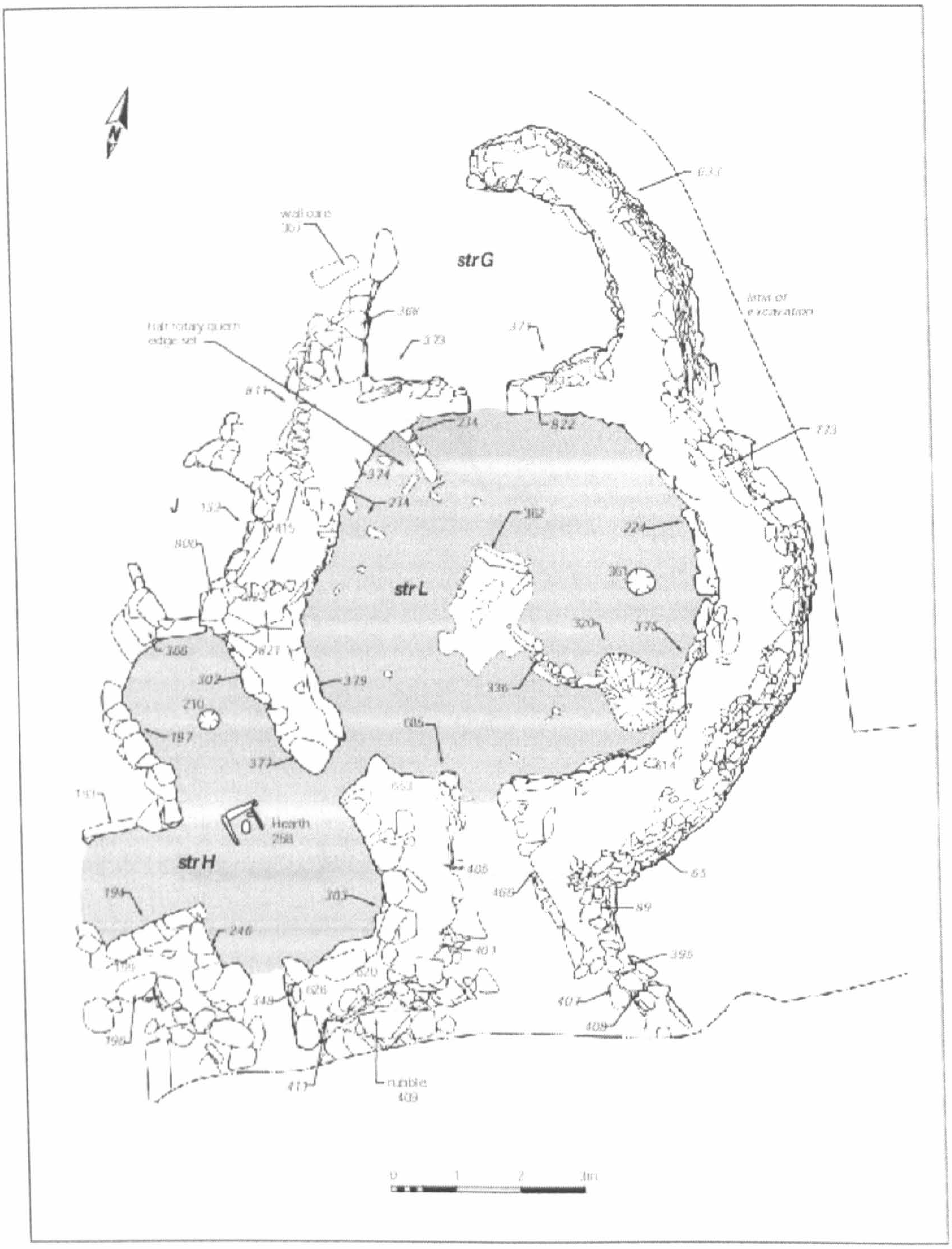


Figure 2.4: House 3: Petal shaped hearth
From Neighbour (2001)

Figure 2.5: House 3: Pre-floor pits
From Neighbour (2001)

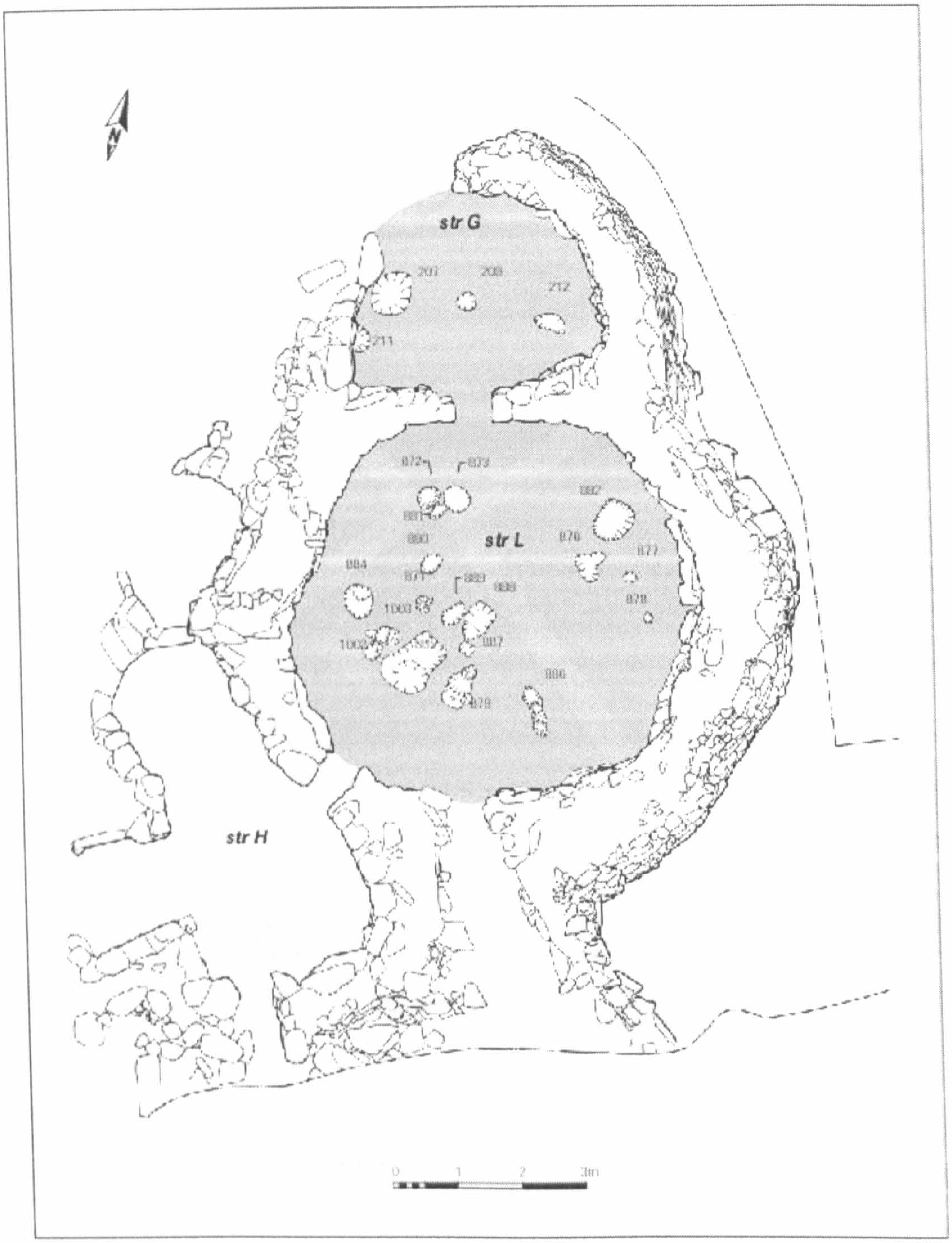


Figure 2.6: House 1: Pre-floor pits
From Neighbour (2001)

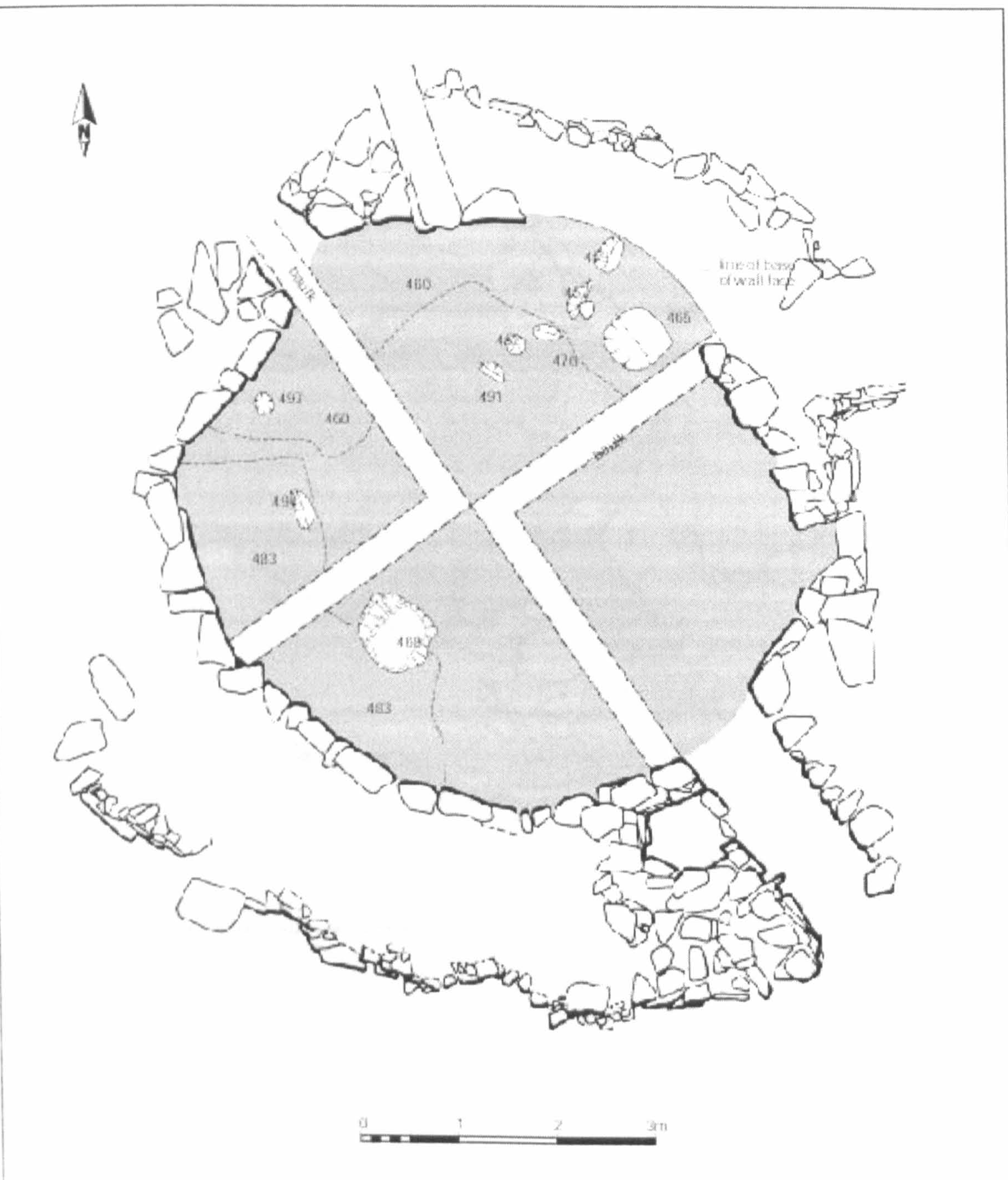


Figure 2.7 House 1: Occupation features
From Neighbour (2001)

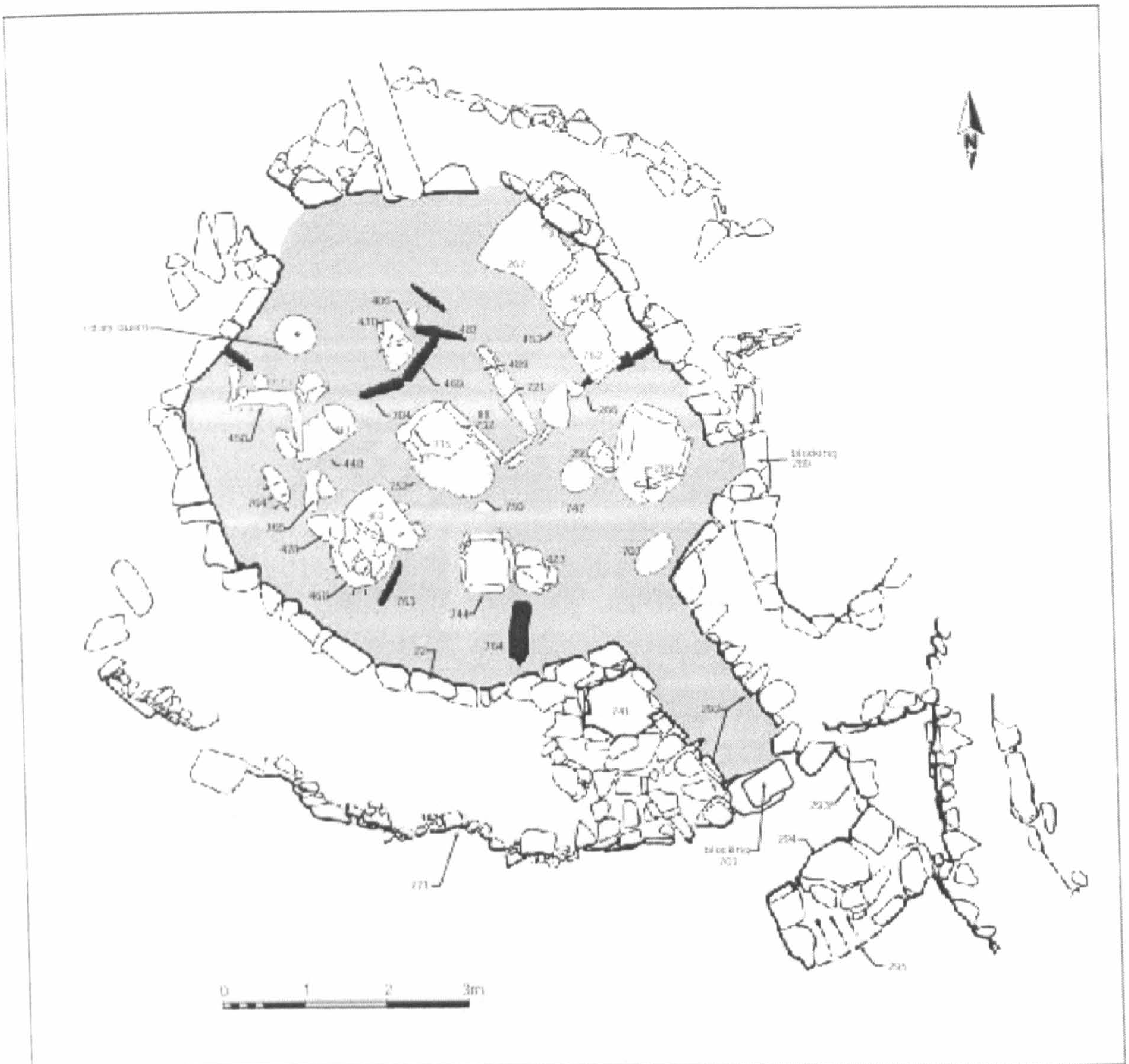


Figure 2.8: House 2: Post-abandonment
From Neighbour (2001)

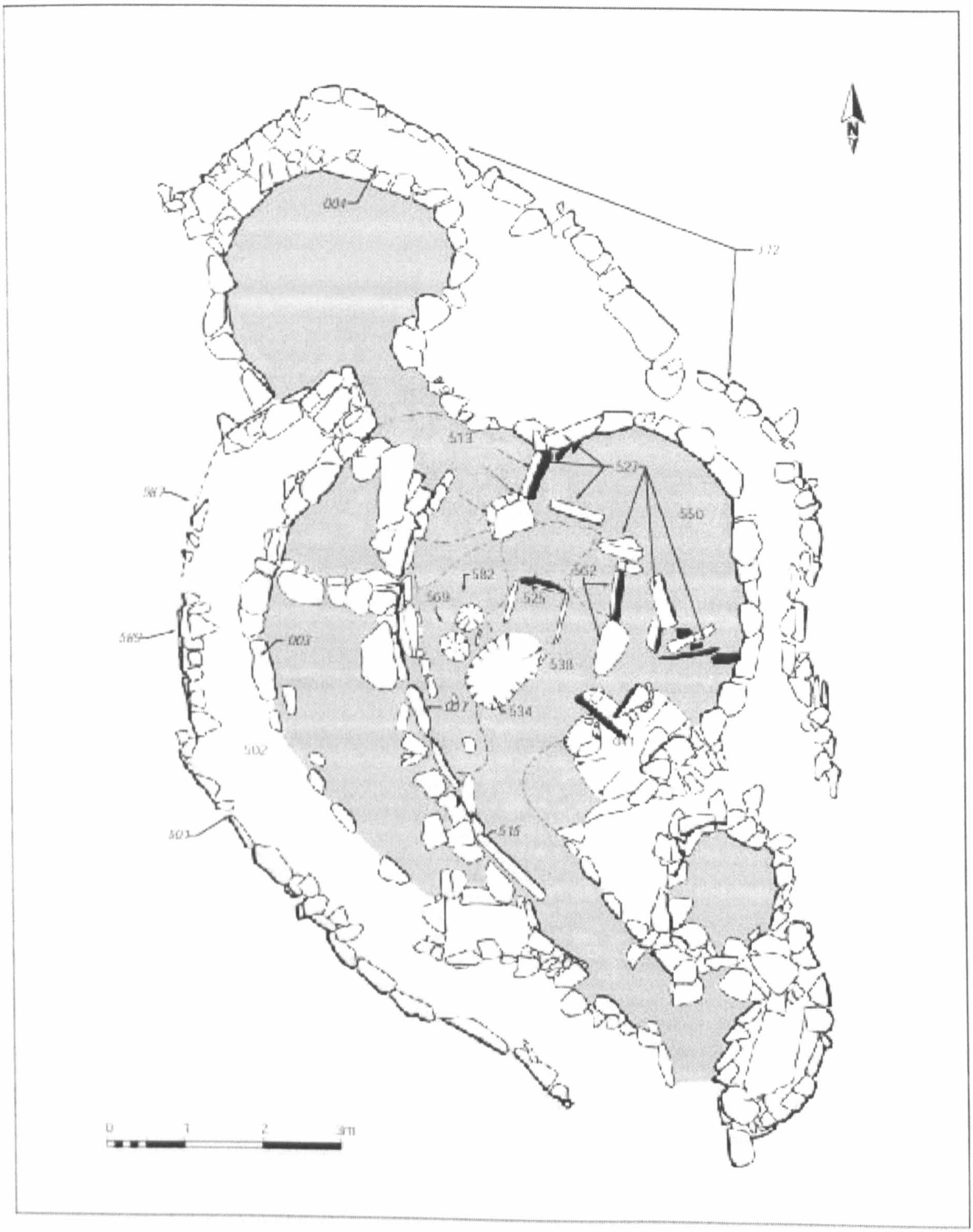


Figure 2.9: House 2: Post-abandonment
From Neighbour (2001)

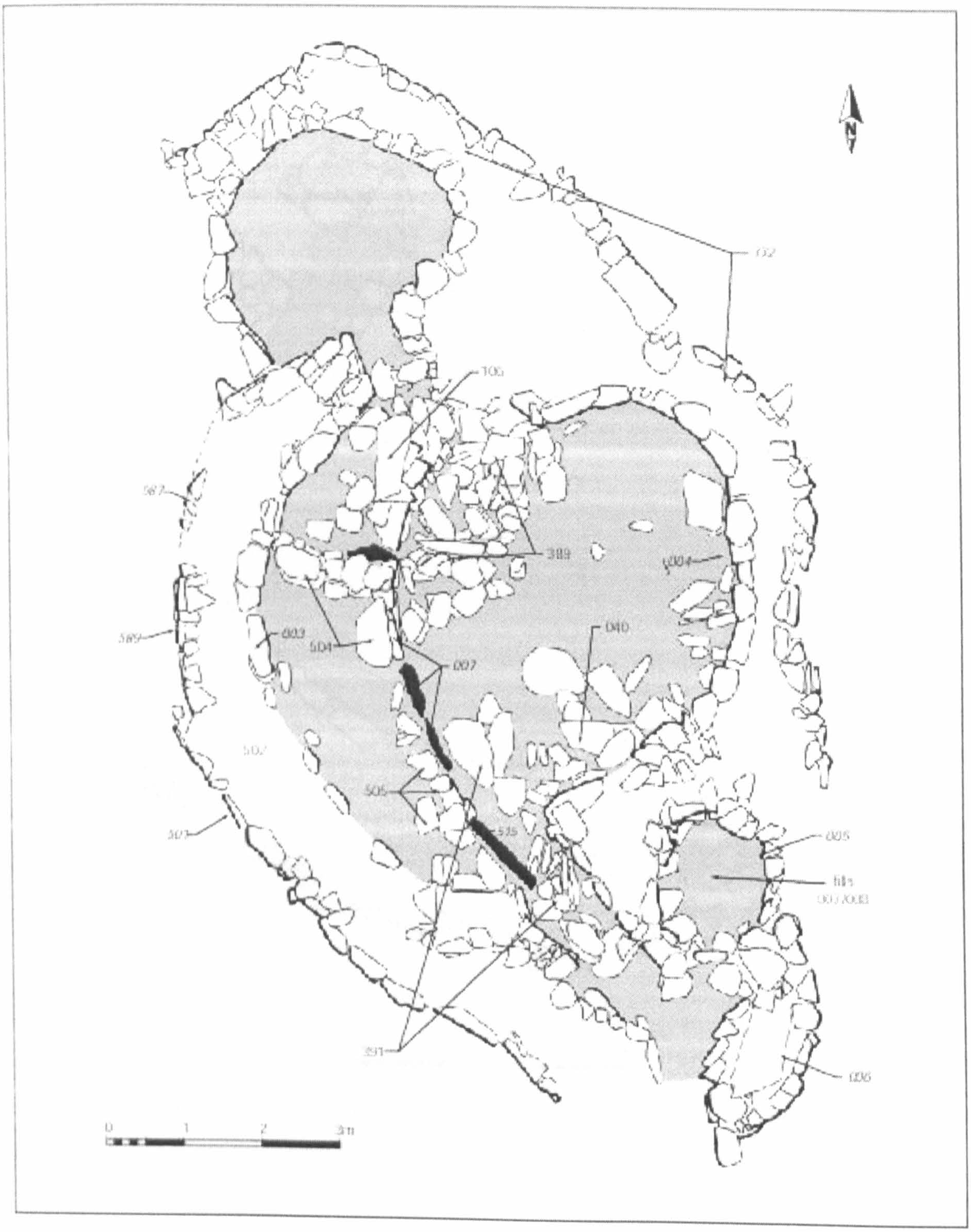


Figure 2.10: House 1, Structure M (Squatter activity)
From Neighbour (2001)

Figure 2.11: House 1, Structure M (post-abandonment)
From Neighbour (2001)

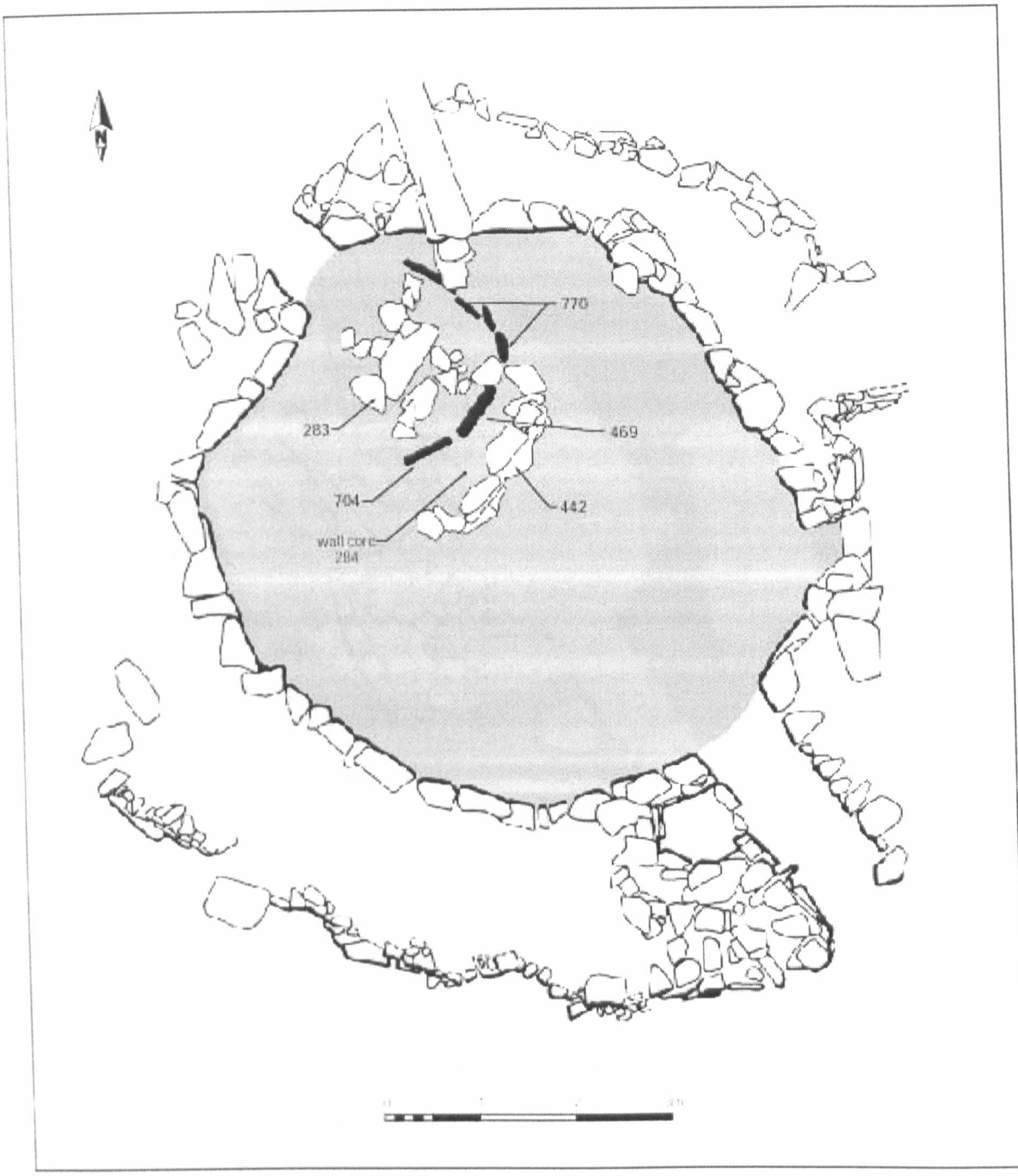


Figure 2.12: Structure A (Norse Age building)
From Neighbour (2001)

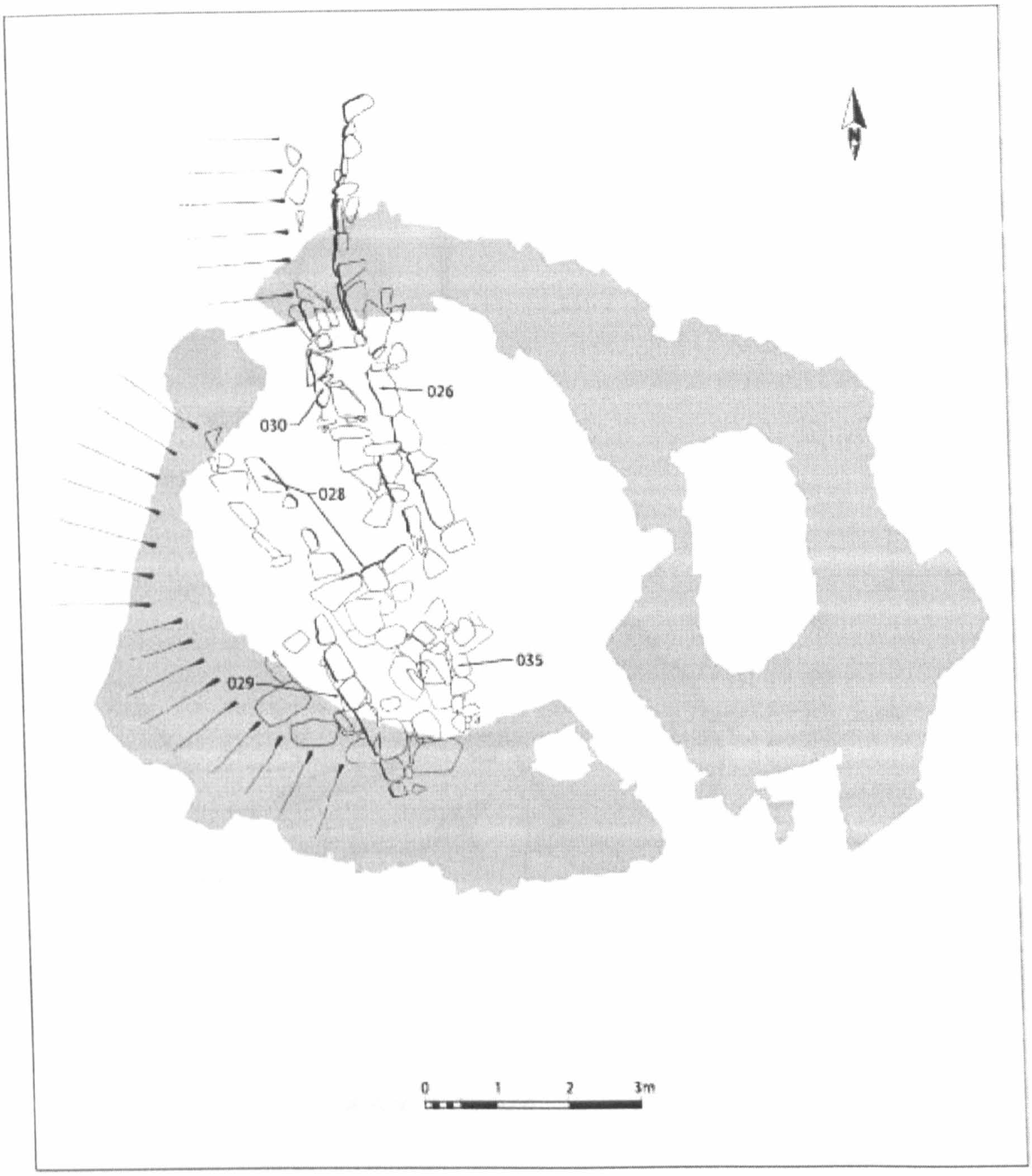


Figure 2.13: House 1 East to West section
From Neighbour (2001)

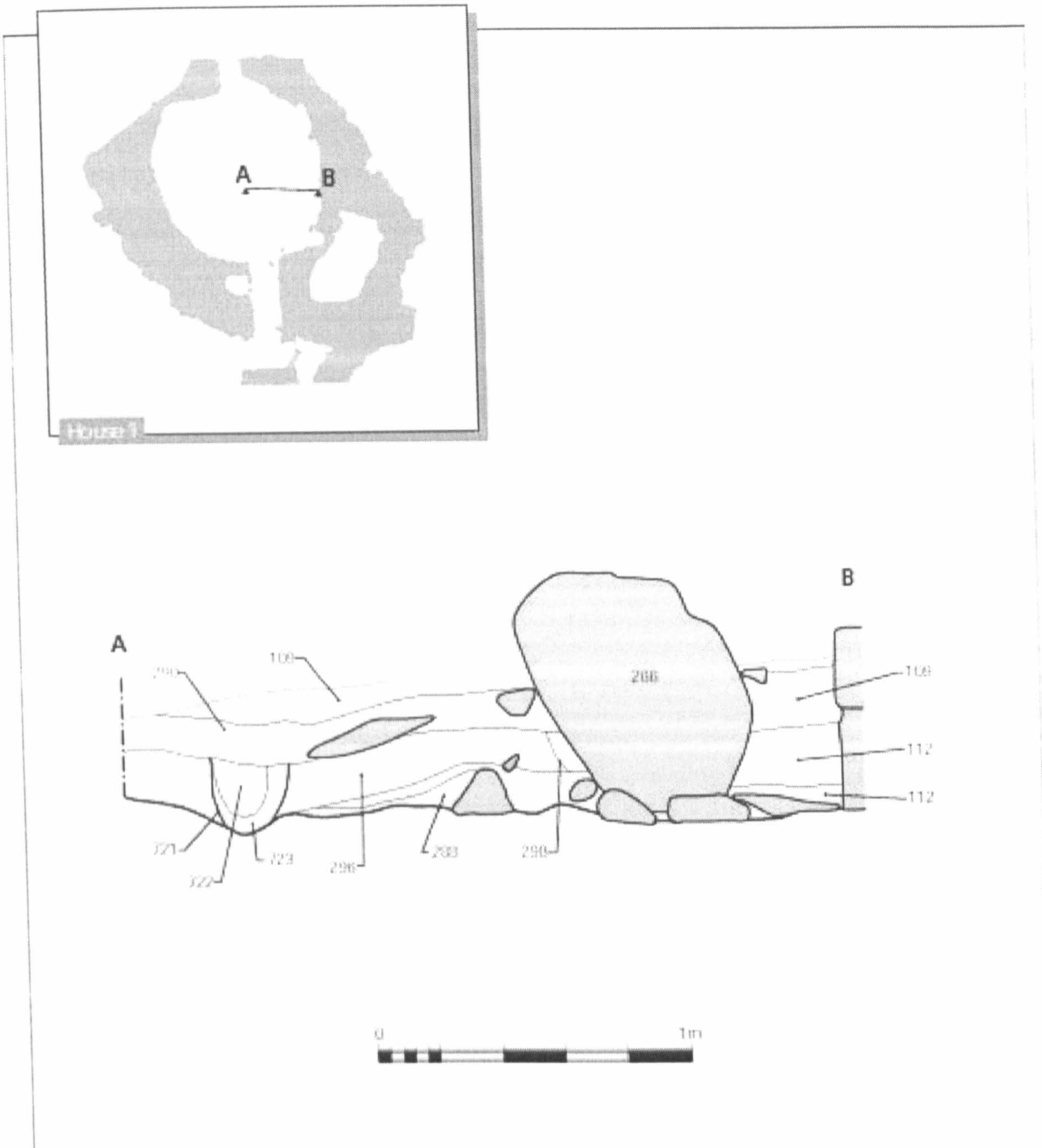


Figure 2.14: House 1: North to South section
From Neighbour (2001)

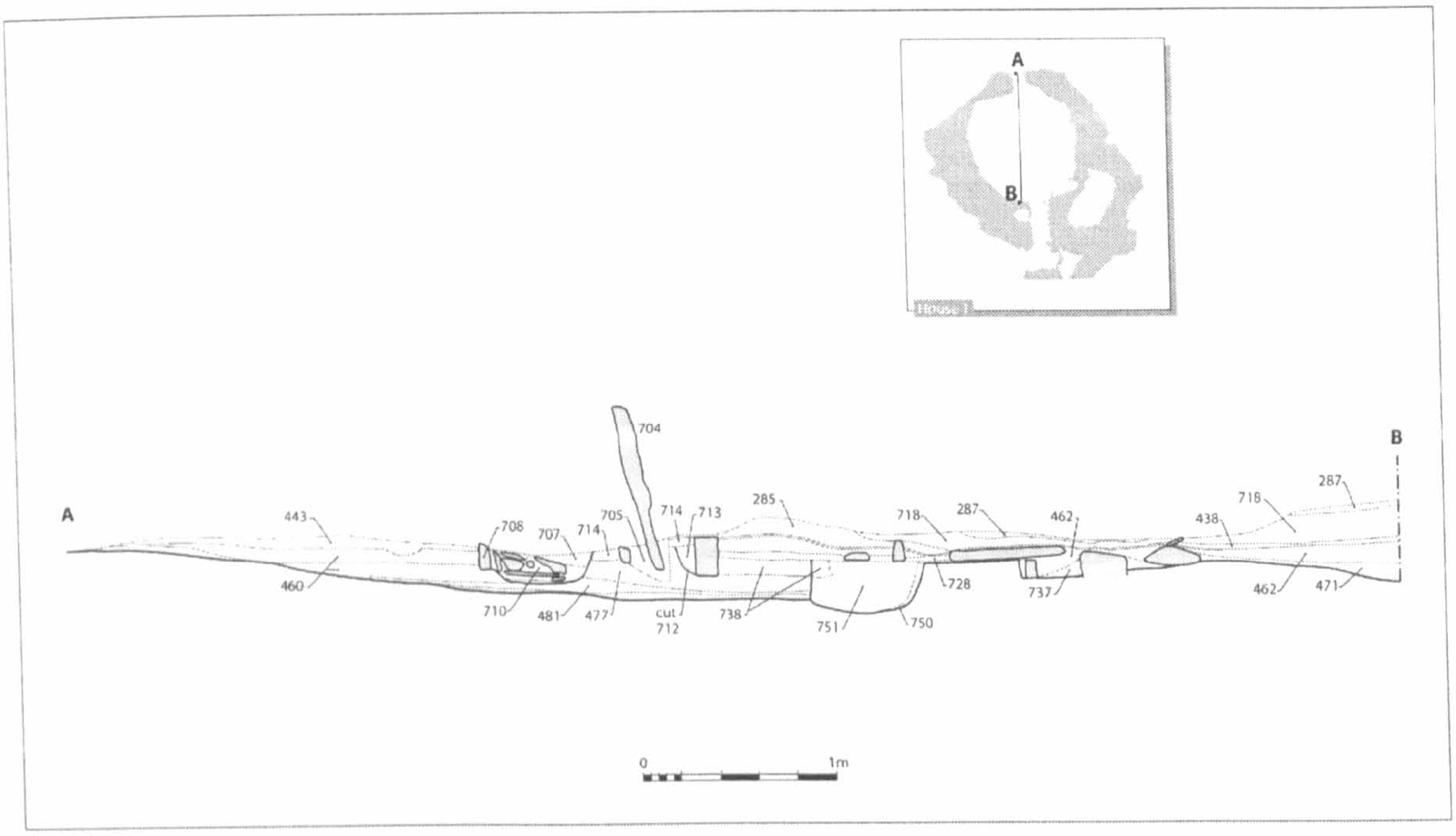


Fig 2.15: House 1: East to West Section From Neighbour (2001)

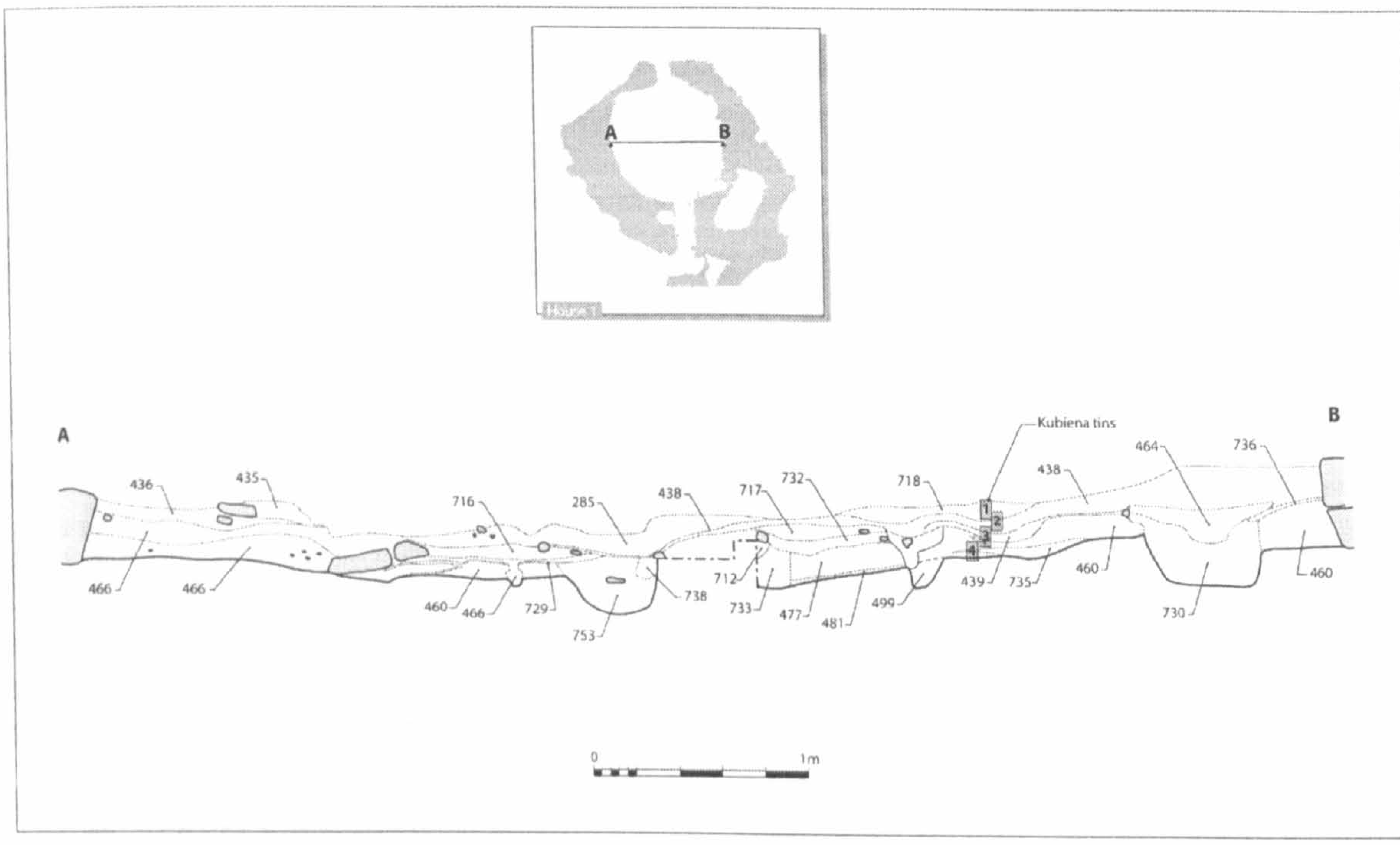
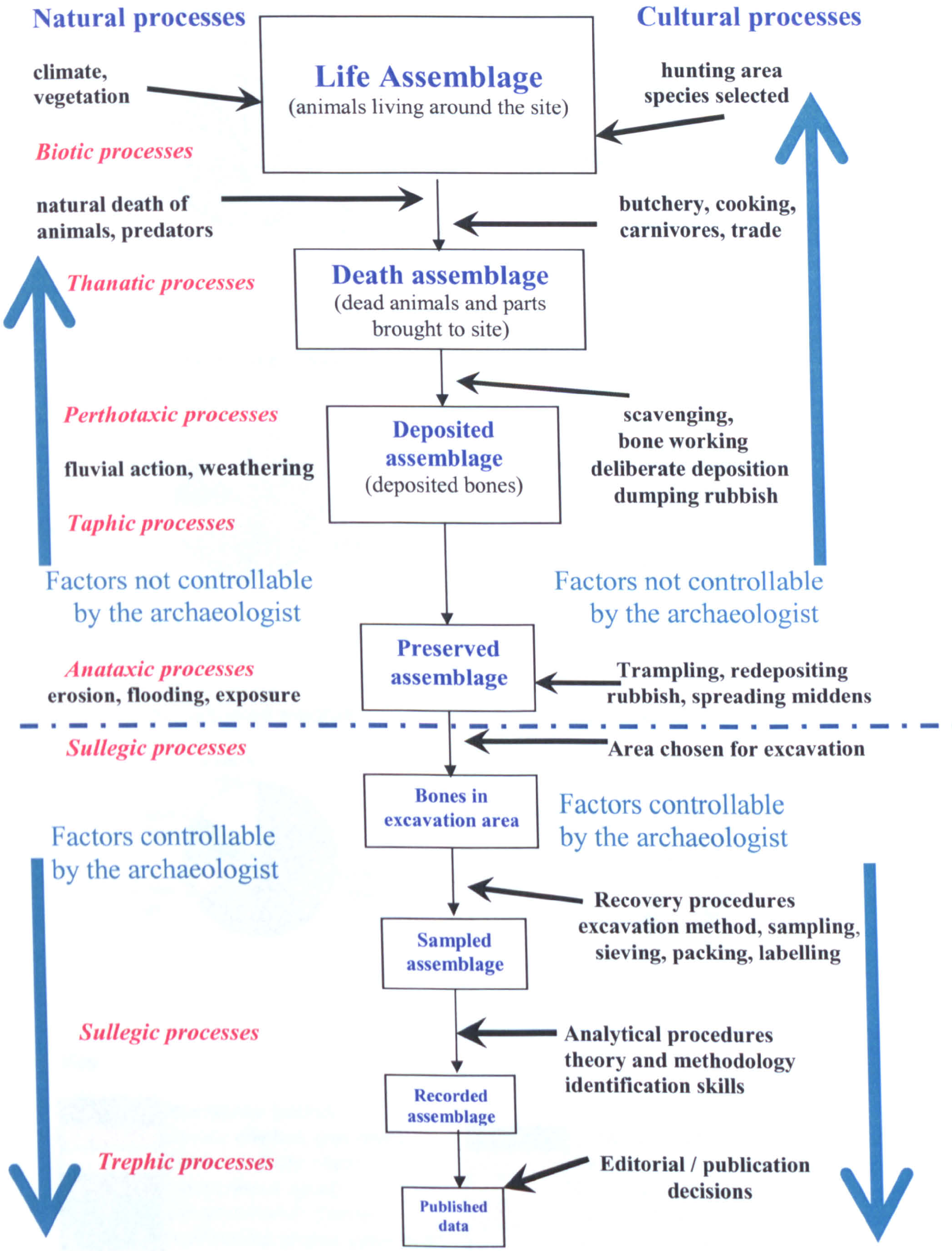


Figure 3.1 Taphonomy



Adapted from Davis (1987, 22), Meadow (1980, 67) and O'Connor (2000, 20 – 21)

Figure 4.1: Bostadh Phase 1 - relative proportions of species

Figure 4.2: Bostadh Phase 2 - relative proportions of species

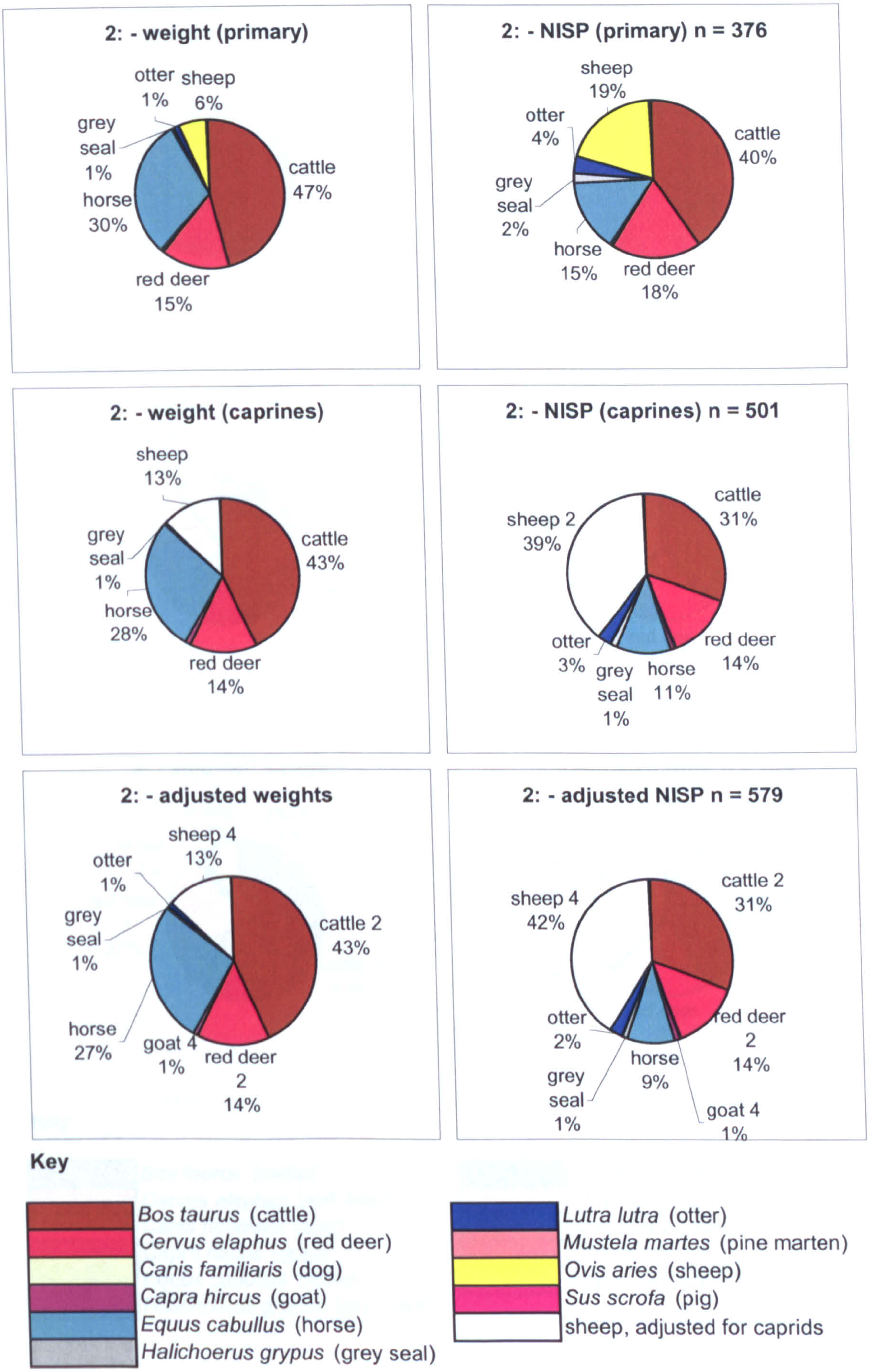


Figure 4.3: Bostadh Phase 3 - relative proportions of species

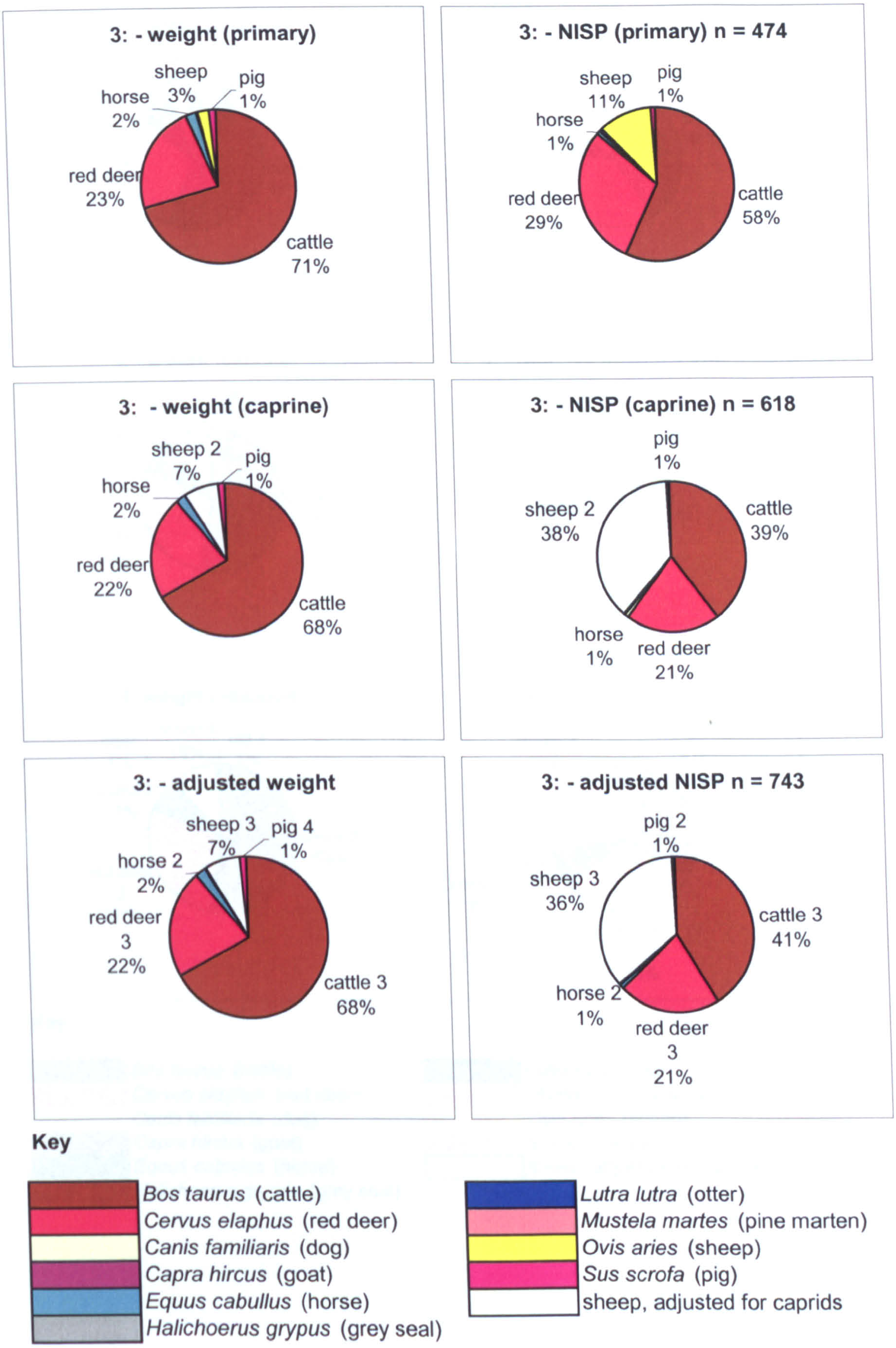


Figure 4.4: Bostadh Phase 4 - relative proportions of species

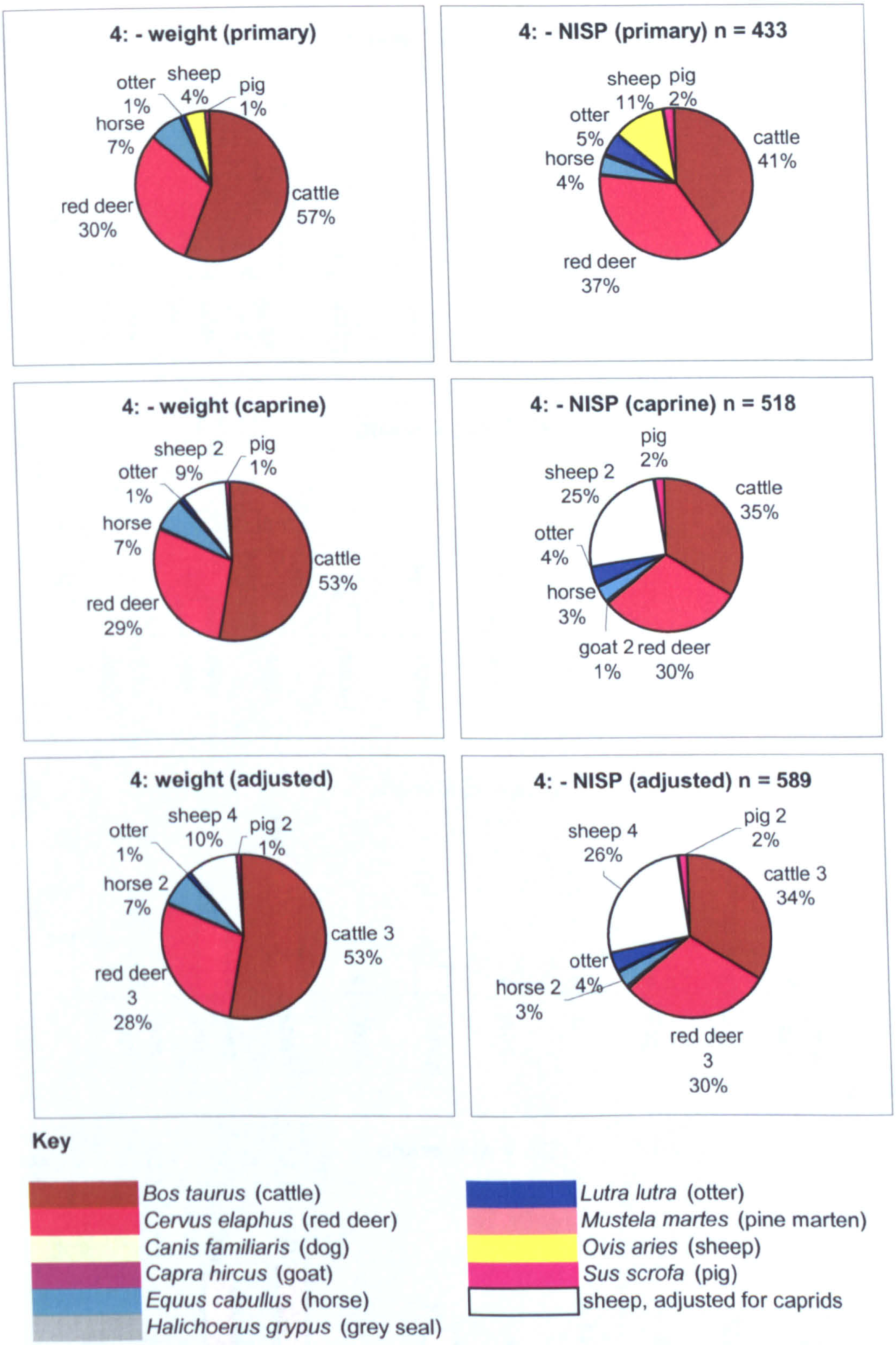


Figure 4.5: NISP by species - primary data, Bostadh

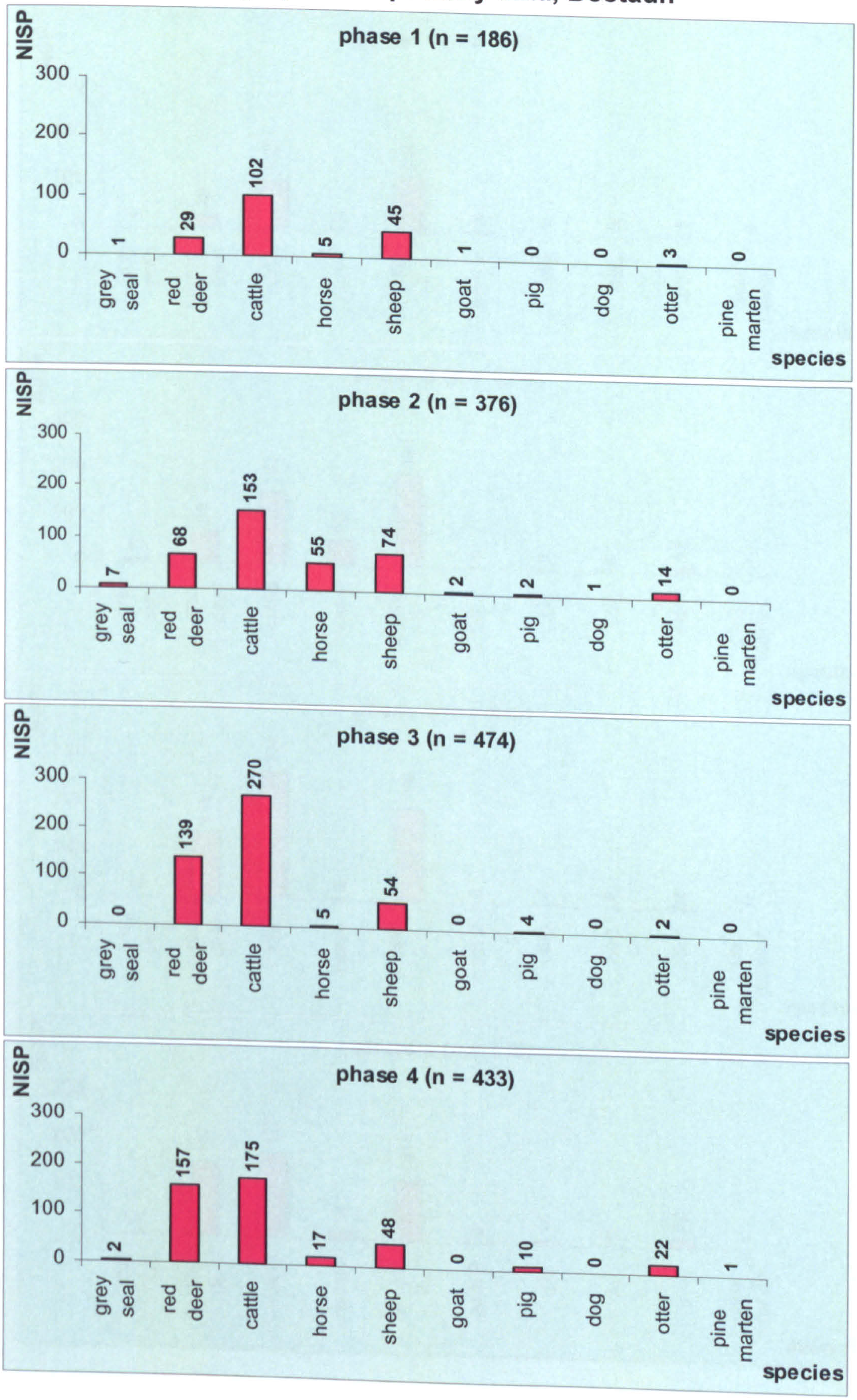


Figure 4.6: NISP figures for Bostadh - adjusted for sheep/goats

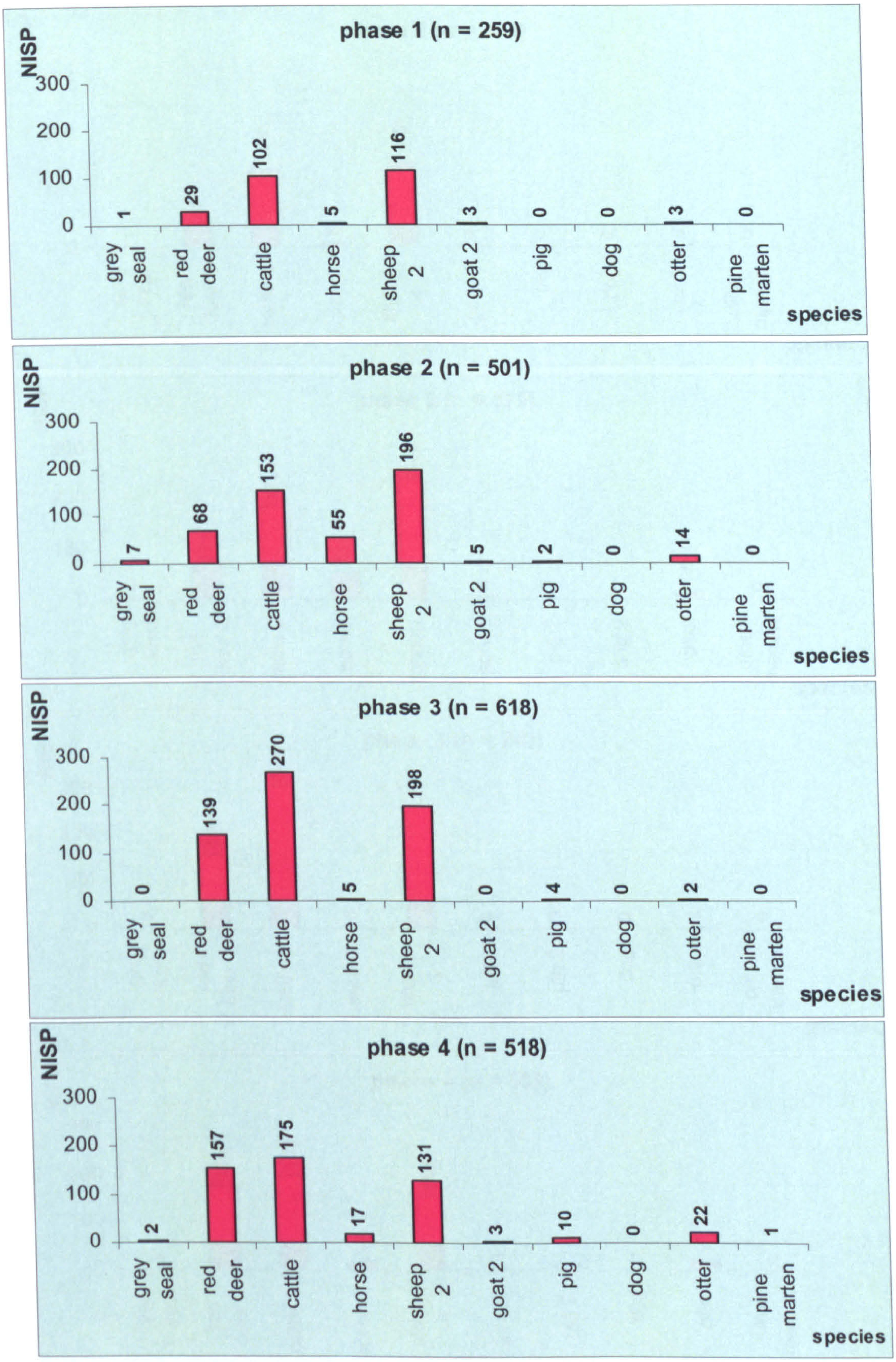


Figure 4.7: Adjusted NISP figures for Bostadh

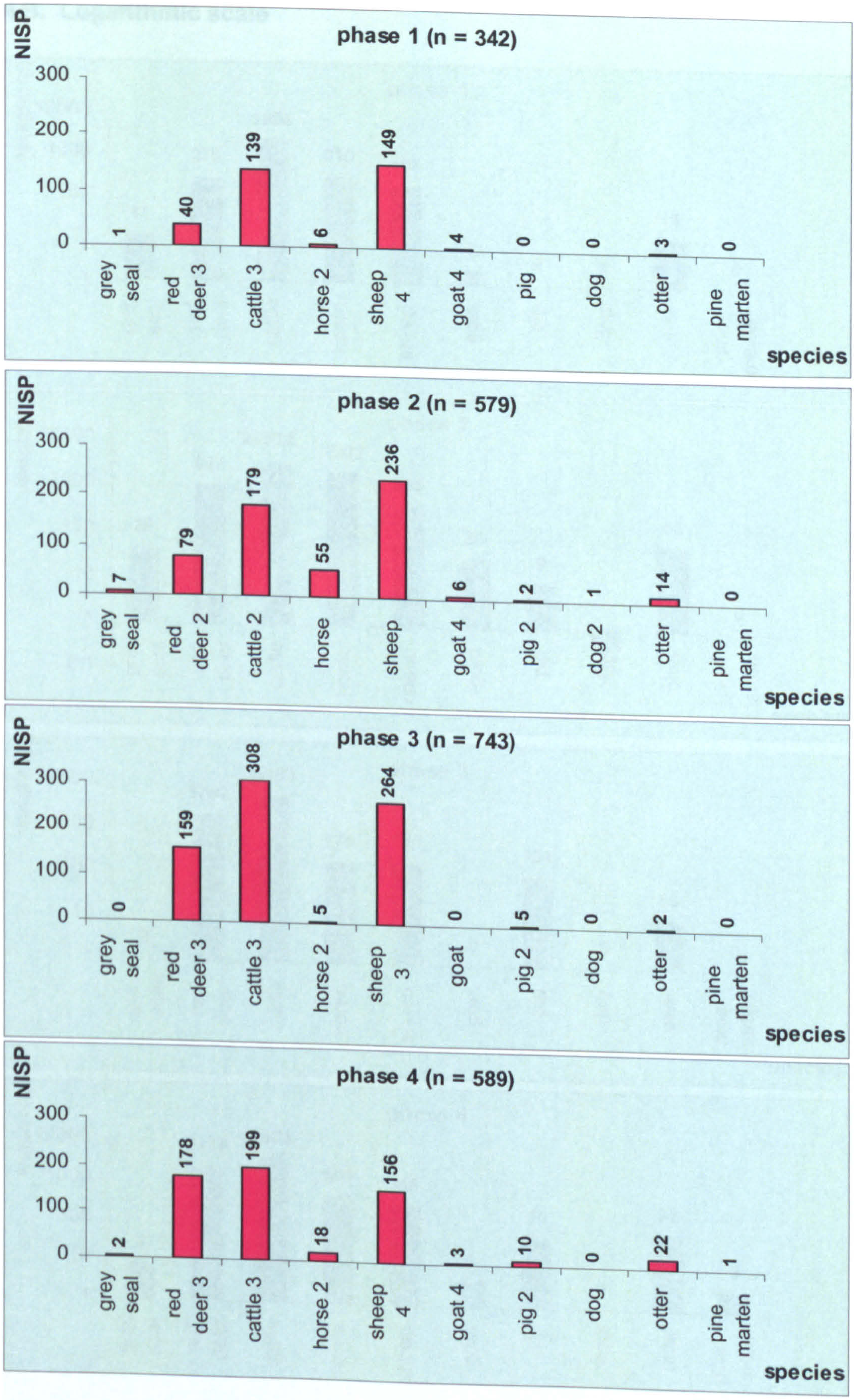


Figure 4.8: weight (g) of identified bone retrieved from Bostadh (primary data)
N.B. Logarithmic scale

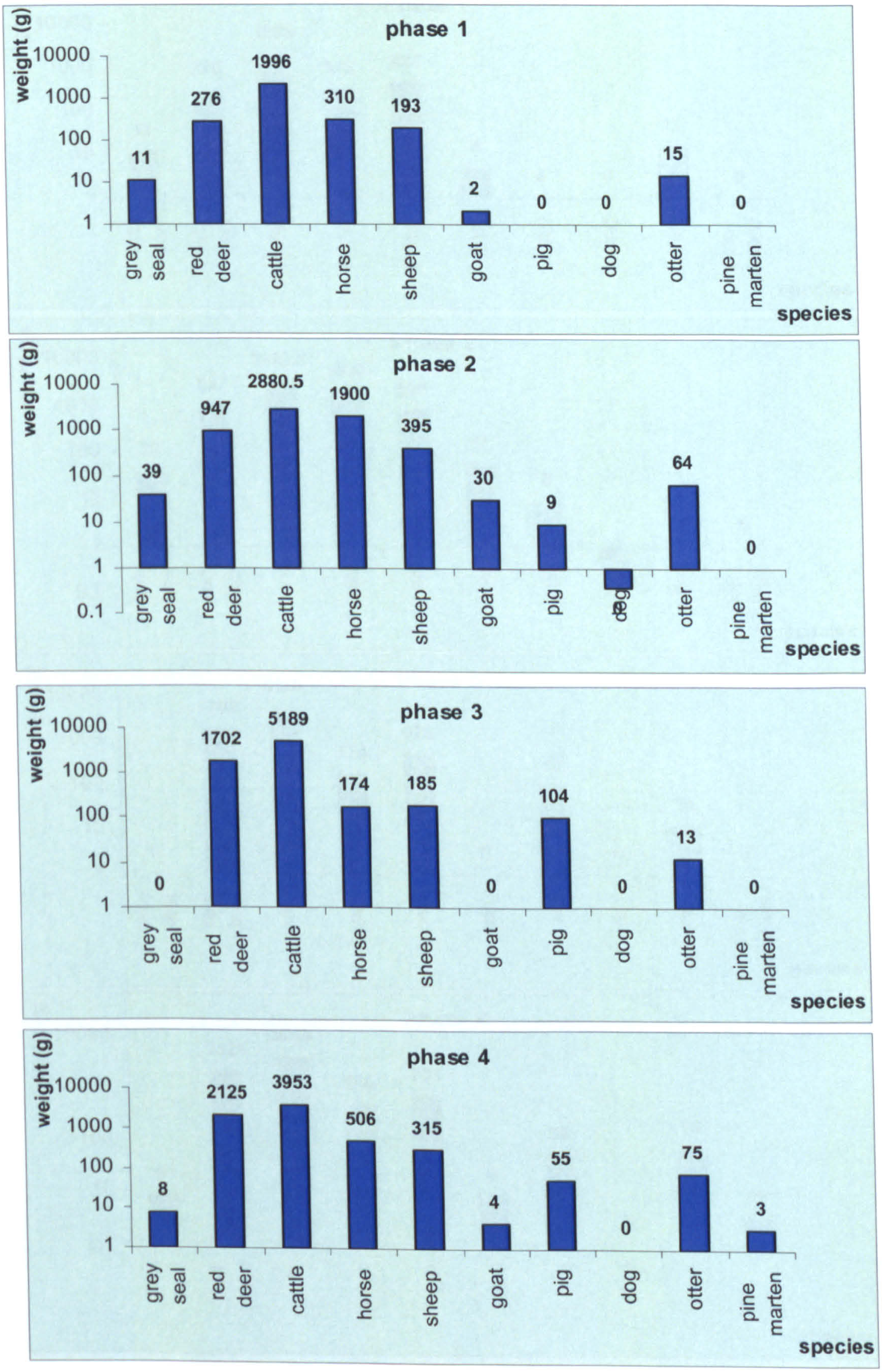


Figure 4.9: weight (g) of identifiable bone retrieved from Bostadh - sheep/goat adjusted
N.B. Logarithmic scale

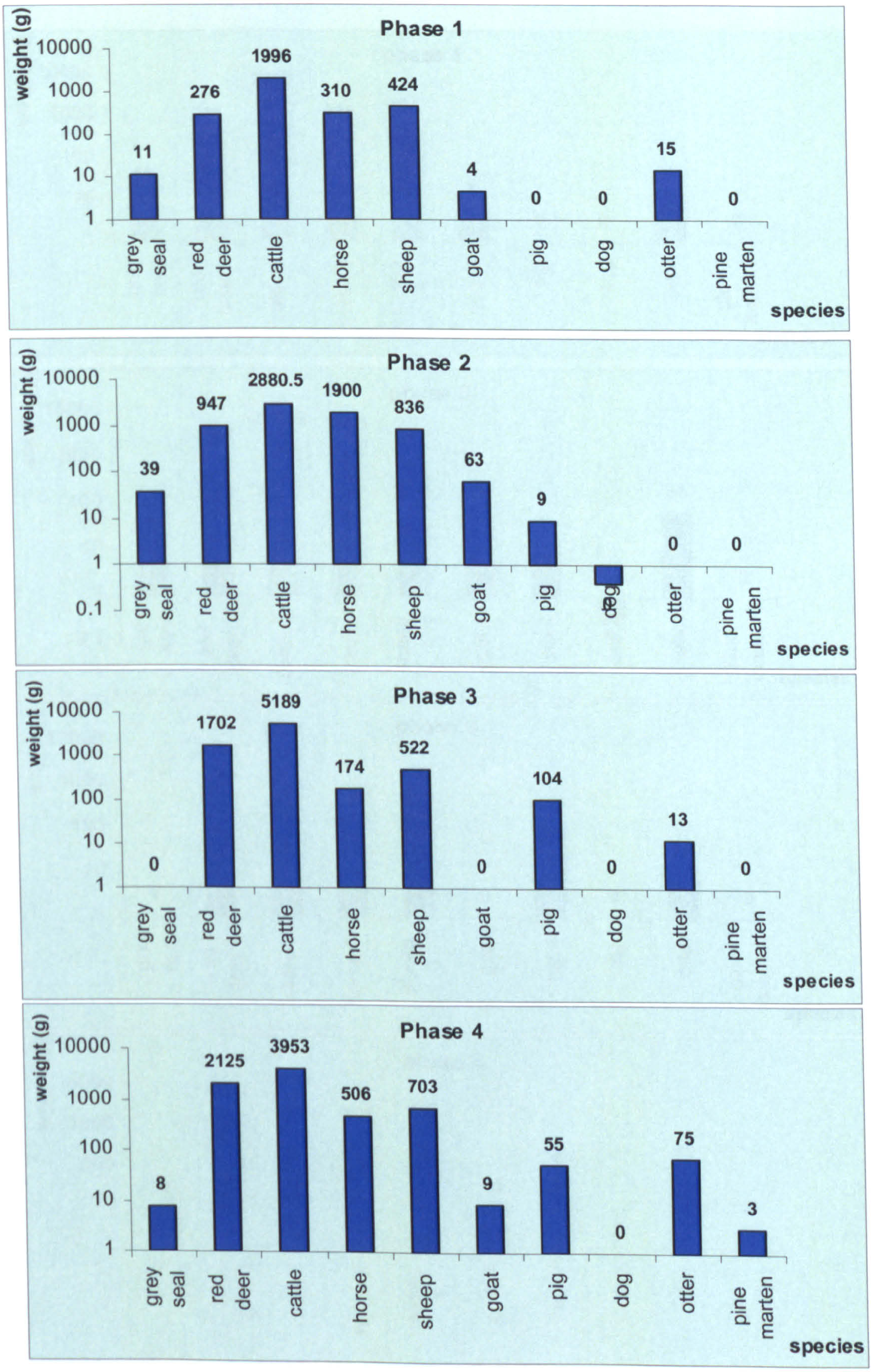


Figure 4.10: weight (g) of identifiable bone retrieved from Bostadh - adjusted figures
N.B. Logarithmic scale

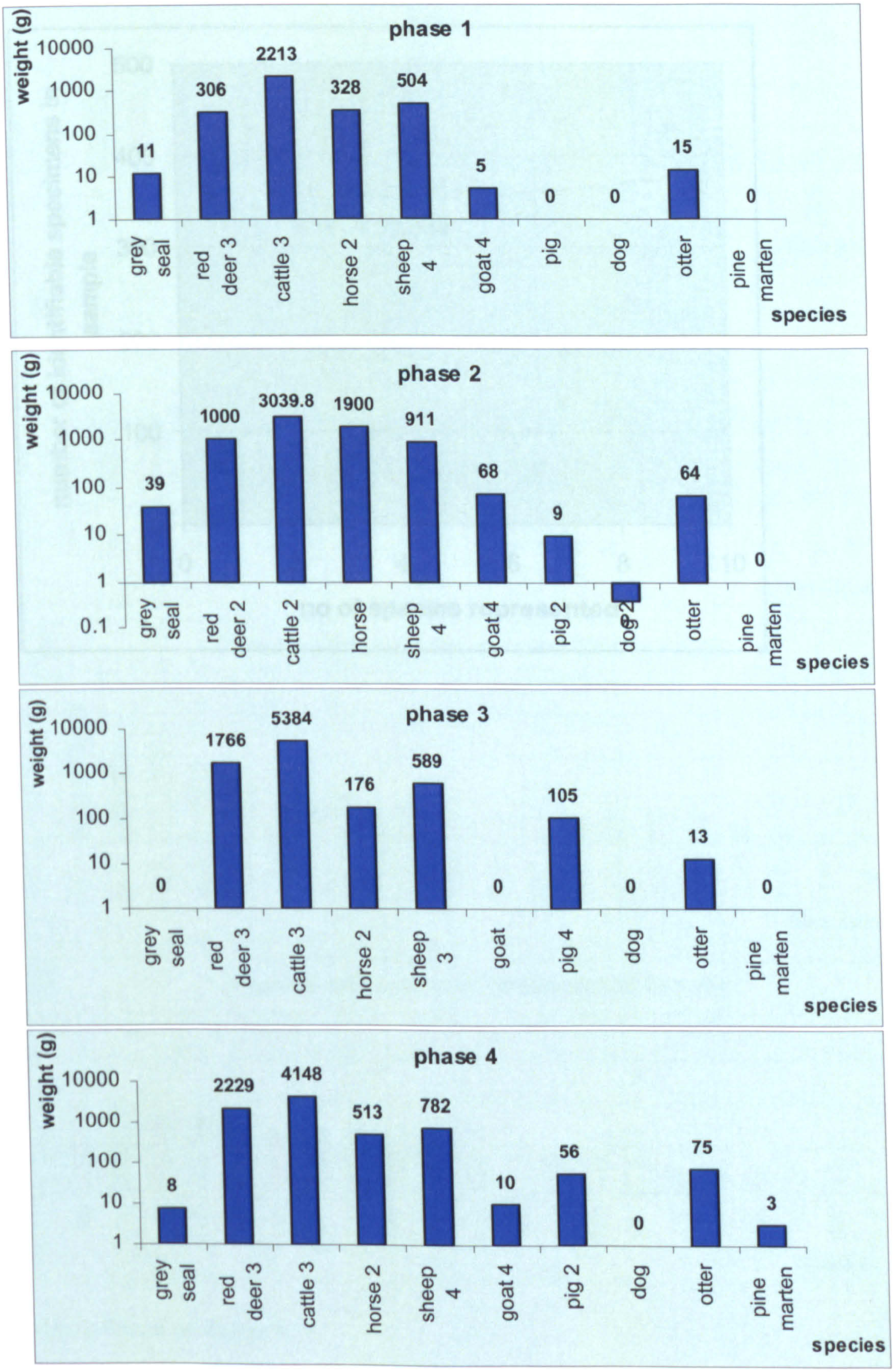


Figure 4.10b: The number of species present in each phase at Bostadh in relation to the number of identifiable specimens retrieved from each phase

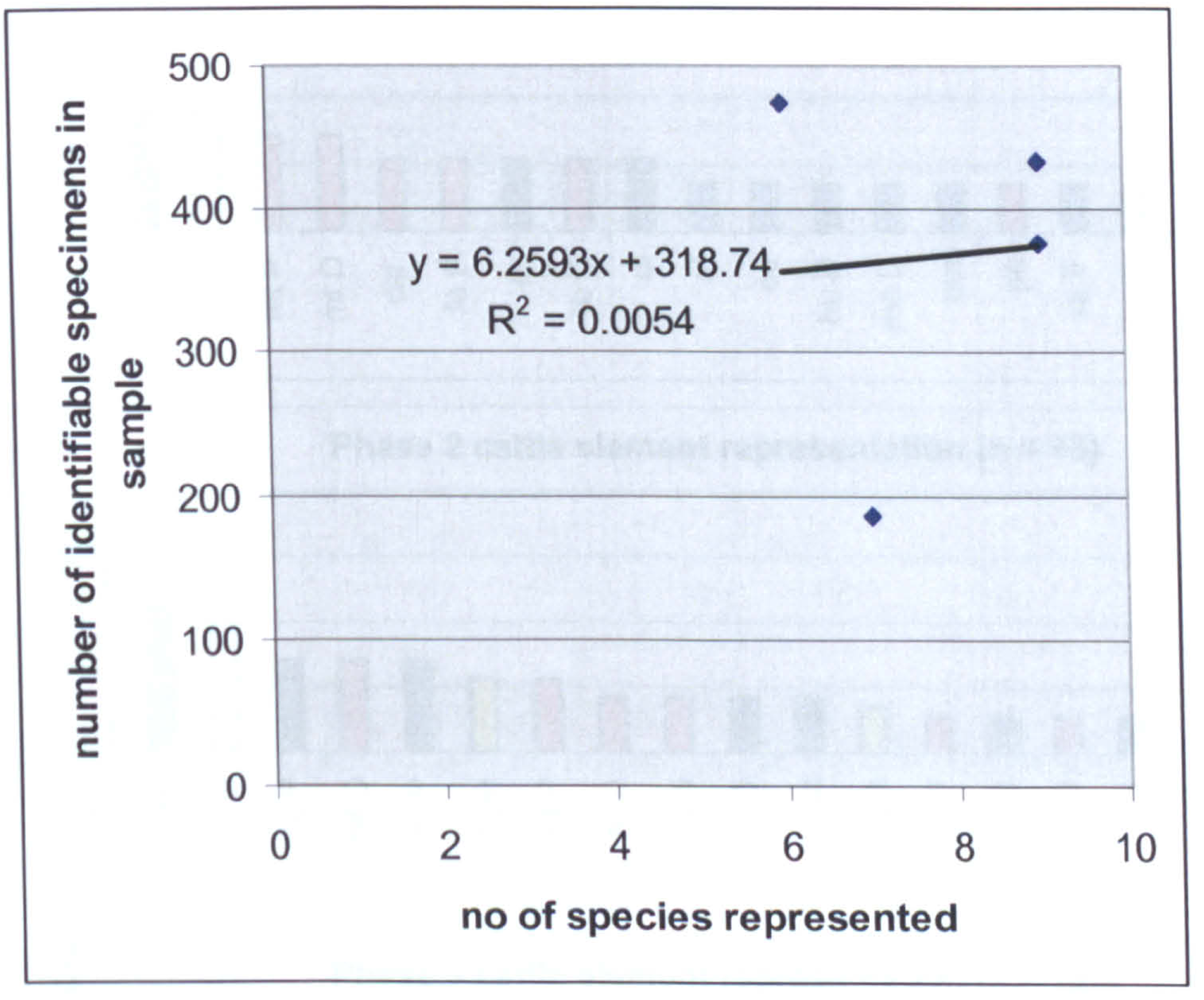
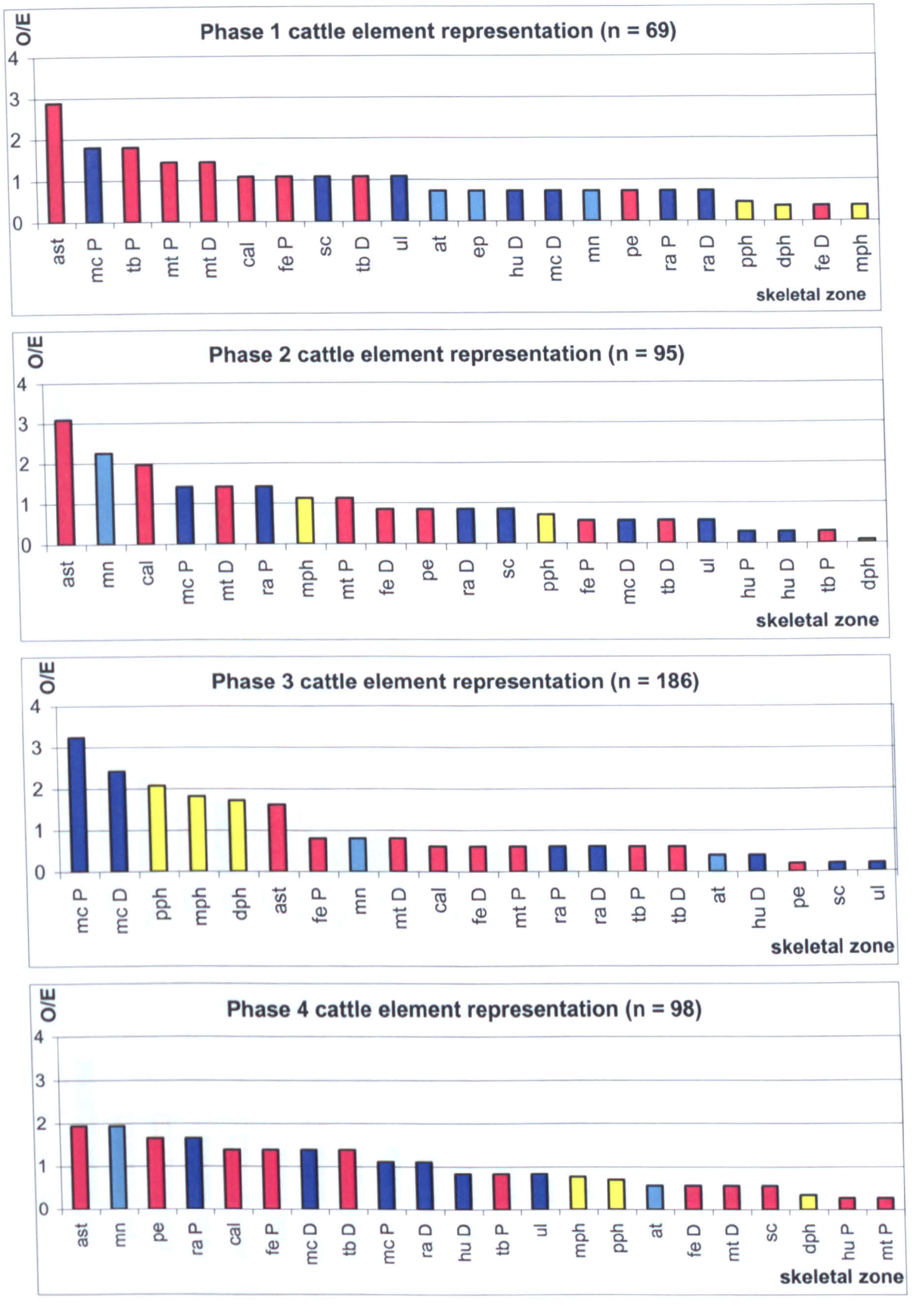
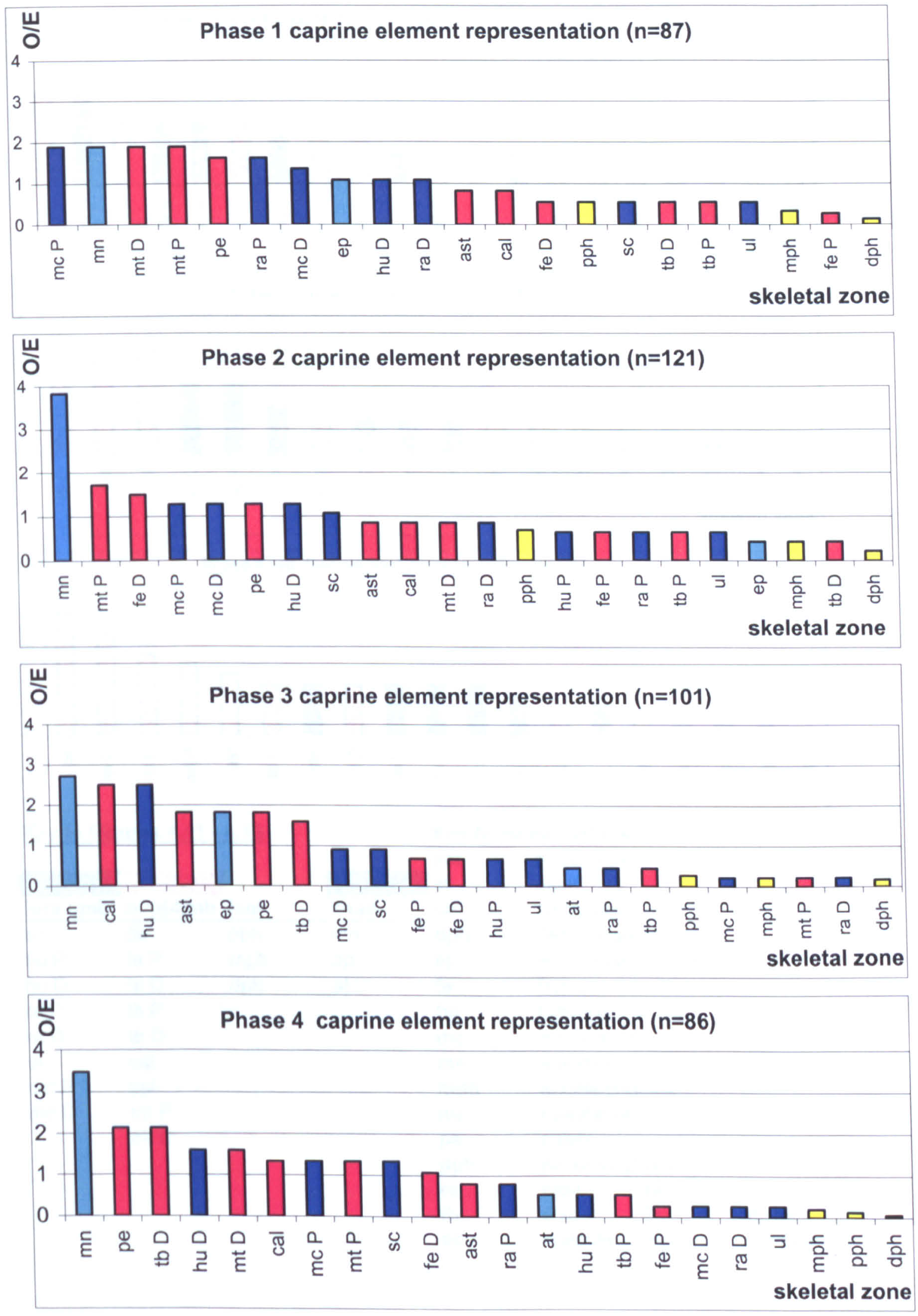


Figure 4.11: Bostadh: element representation - cattle



Key to Figure on Figure 4.13

Figure 4.12: Bostadh: element representation - caprines



Key to Figure on Figure 4.13

Figure 4.13: Bostadh: Red deer element representation

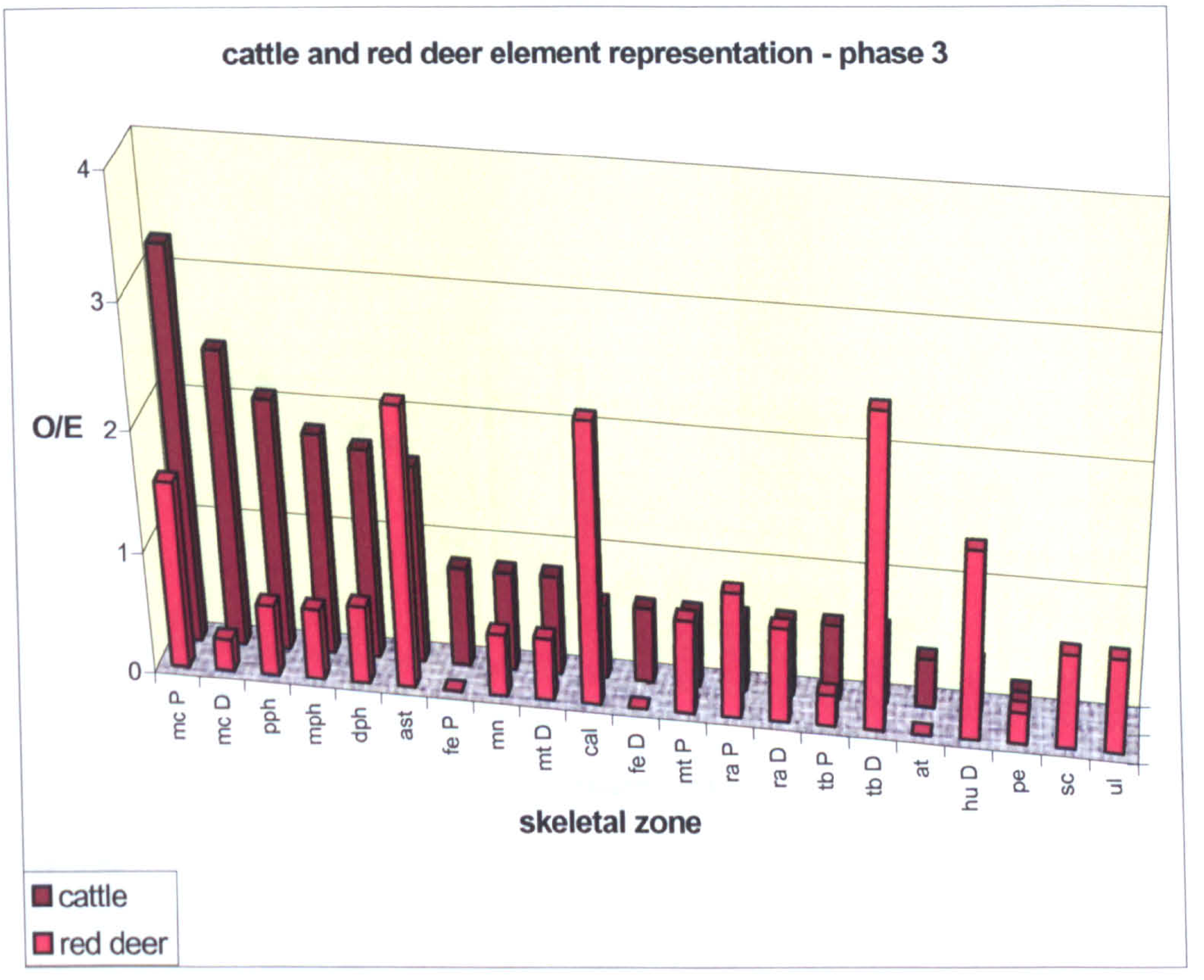
Key to Figures 4.11 - 4.13

fore-limb	hind-limb	feet	head
sc	pe	pph	mn
hu P	fe P	mph	ep
hu D	fe D	dph	at
ra P	tb P		
ra D	tb D		
ul	cal		
mc P	ast		
mc D	mt P		
	mt D		

Key to abbreviations

ast	astragalus		
at	atlas		
cal	calcaneum		
dph	distal phalanx		
ep	epistropheus (axis)		
fe	femur		
hu	humerus		
mc	metacarpal		
mn	mandible		
mph	middle phalanx		
mt	metatarsal		
pe	pelvis		
pph	proximal phalanx		
ra	radius	**ul**	ulna
tb	tibia	**D**	distal
sc	scapula	**P**	proximal

Figure 4.14: cattle and red deer element representation at Bostadh



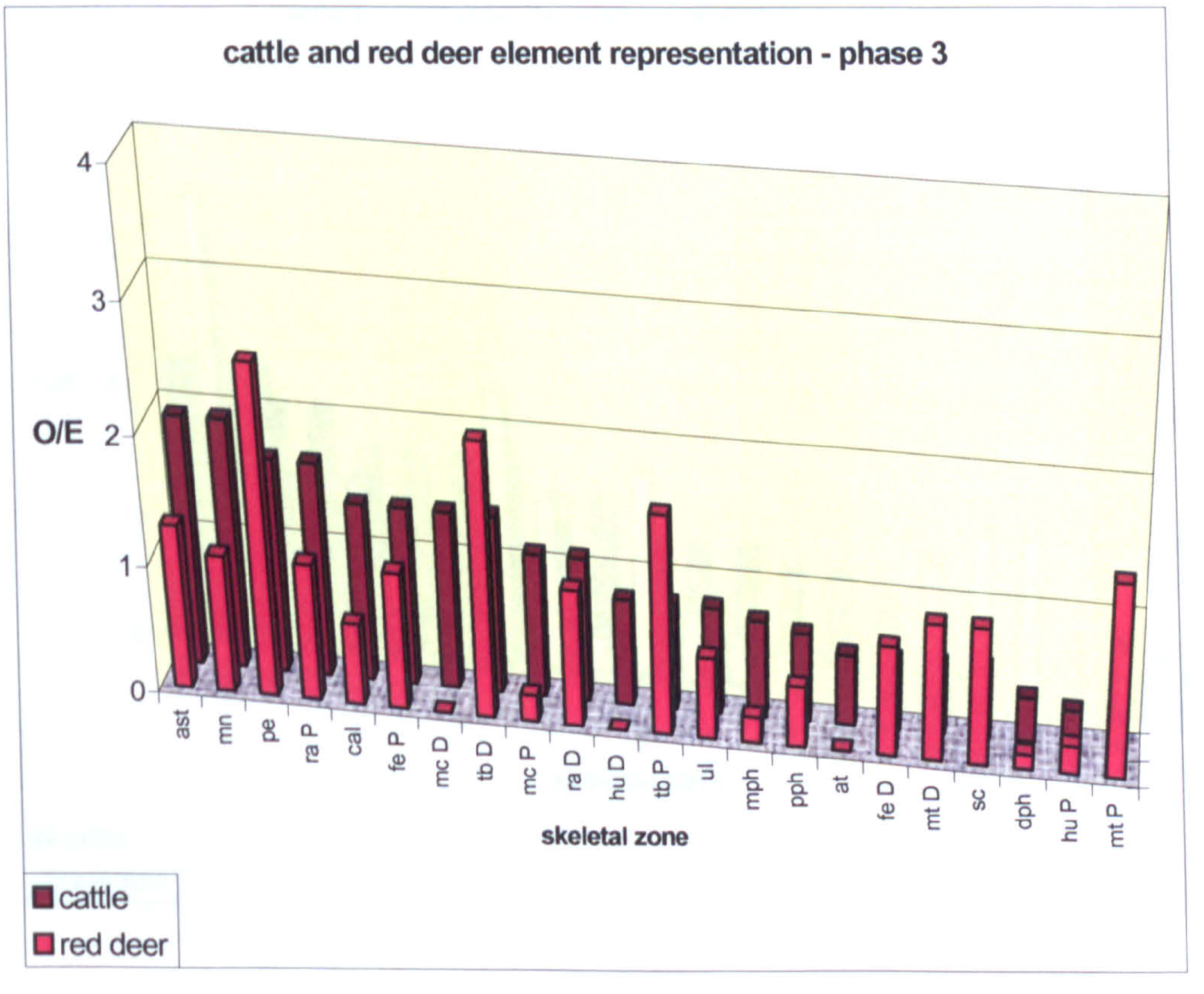
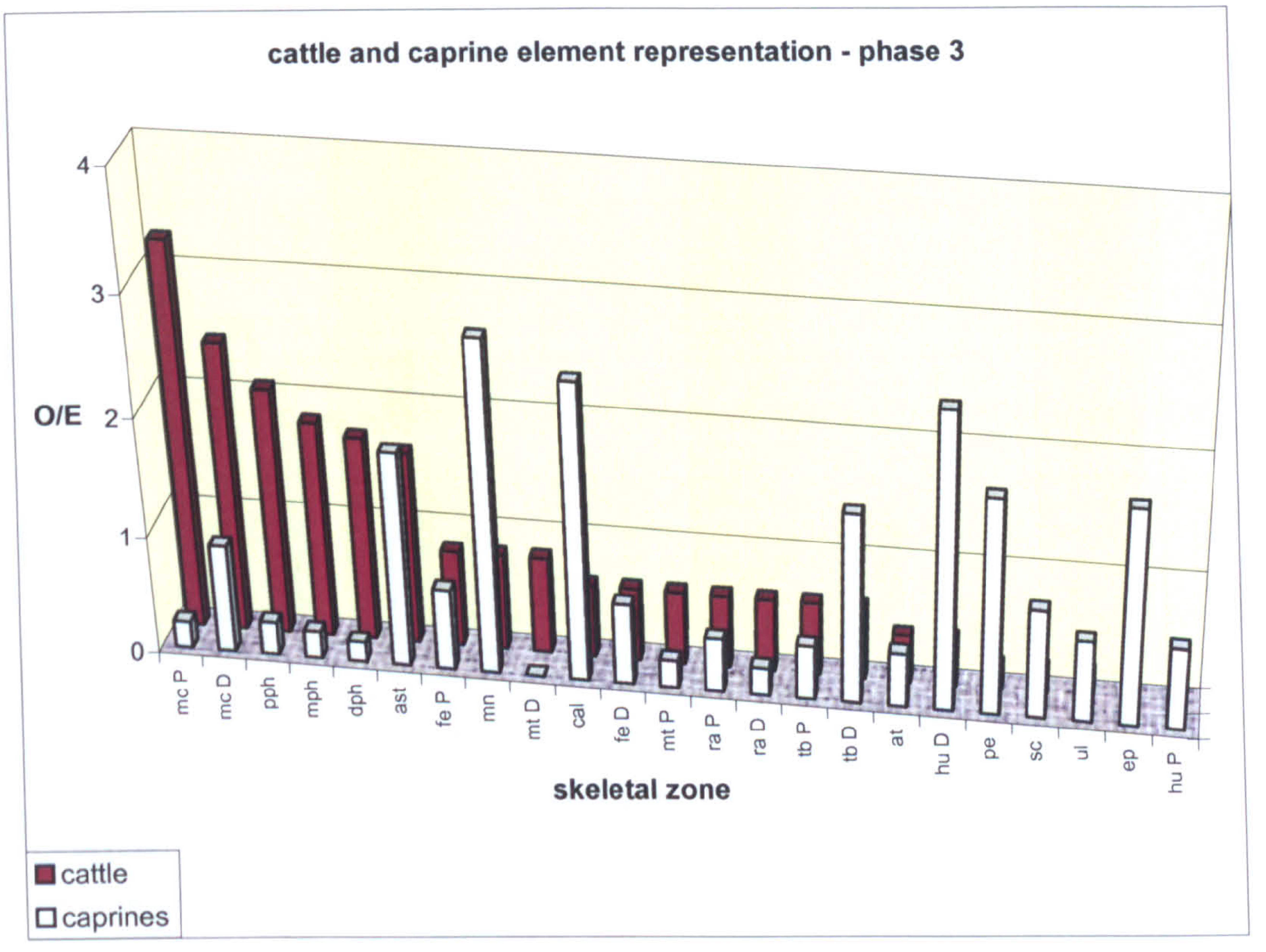


Figure 4.15: cattle and caprine element representation at Bostadh



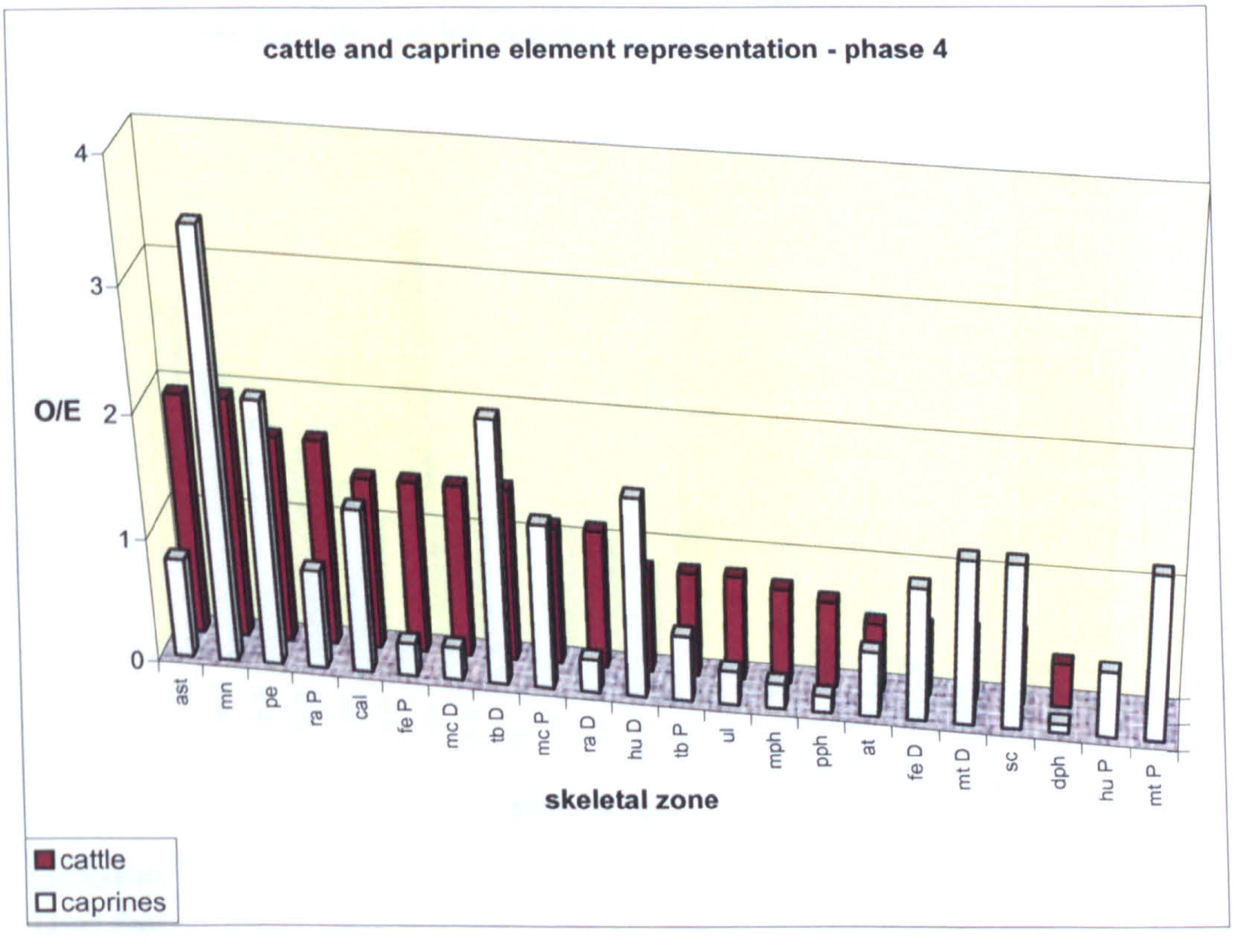
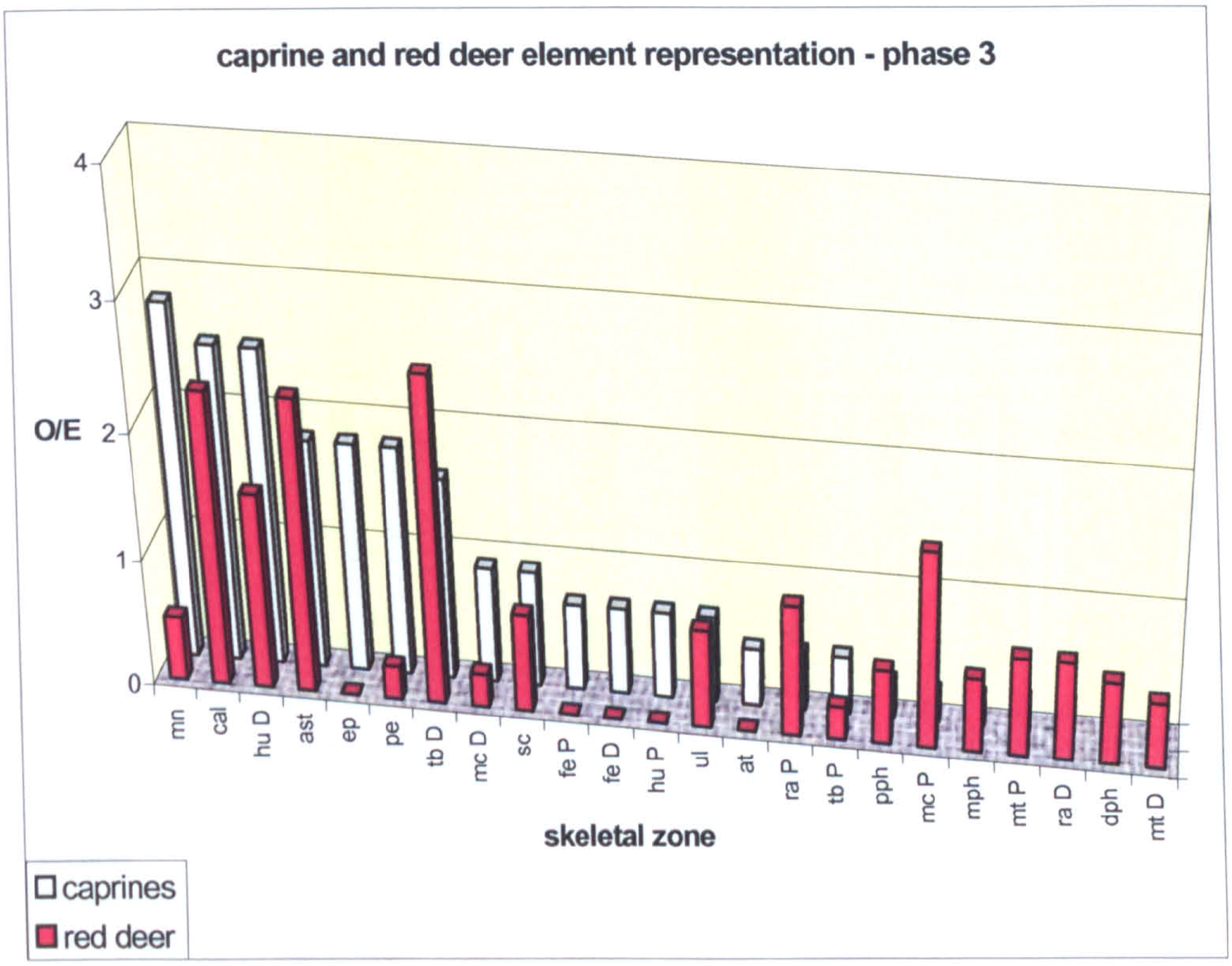


Figure 4.16: caprine and red deer element representation for Bostadh



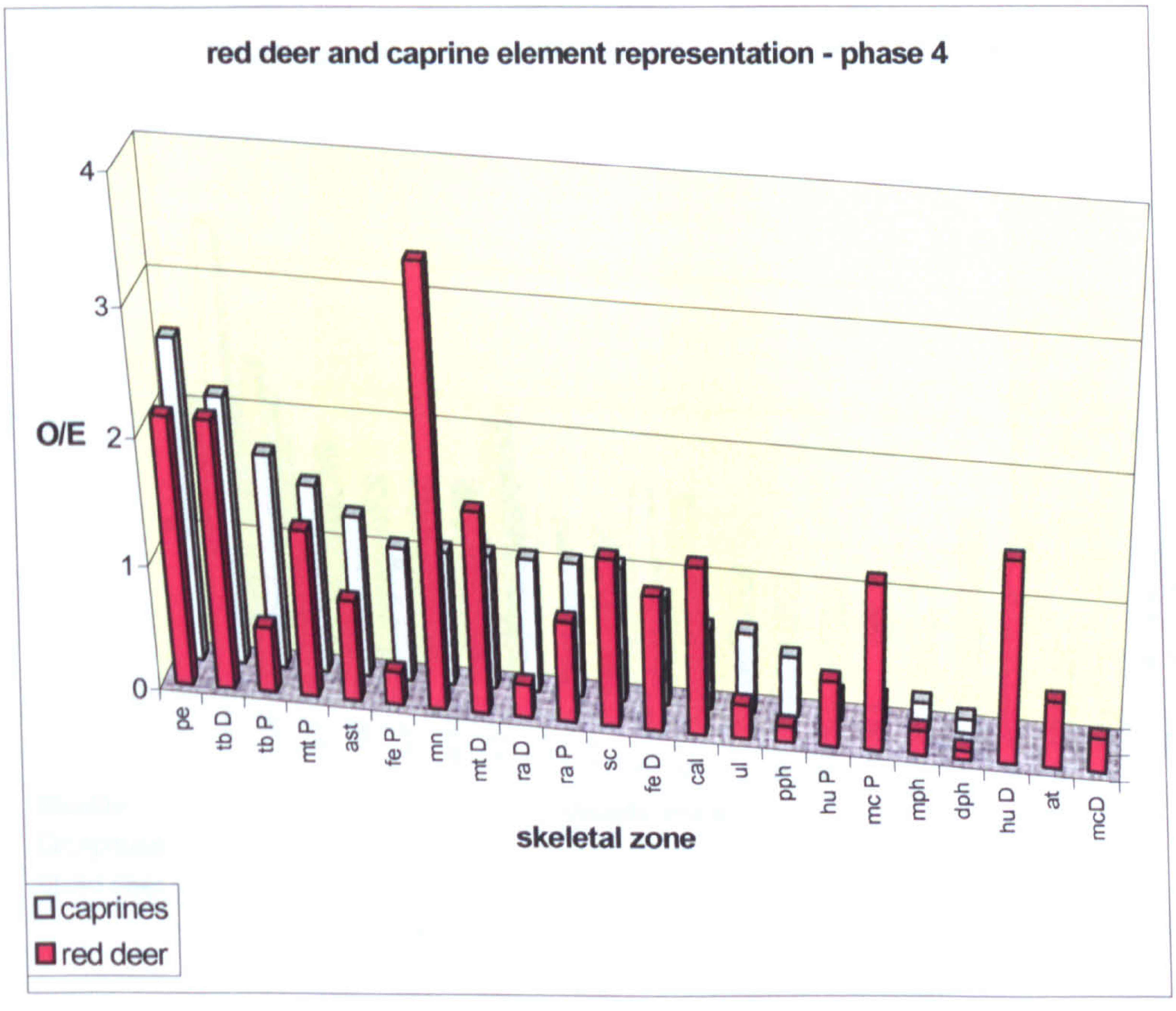
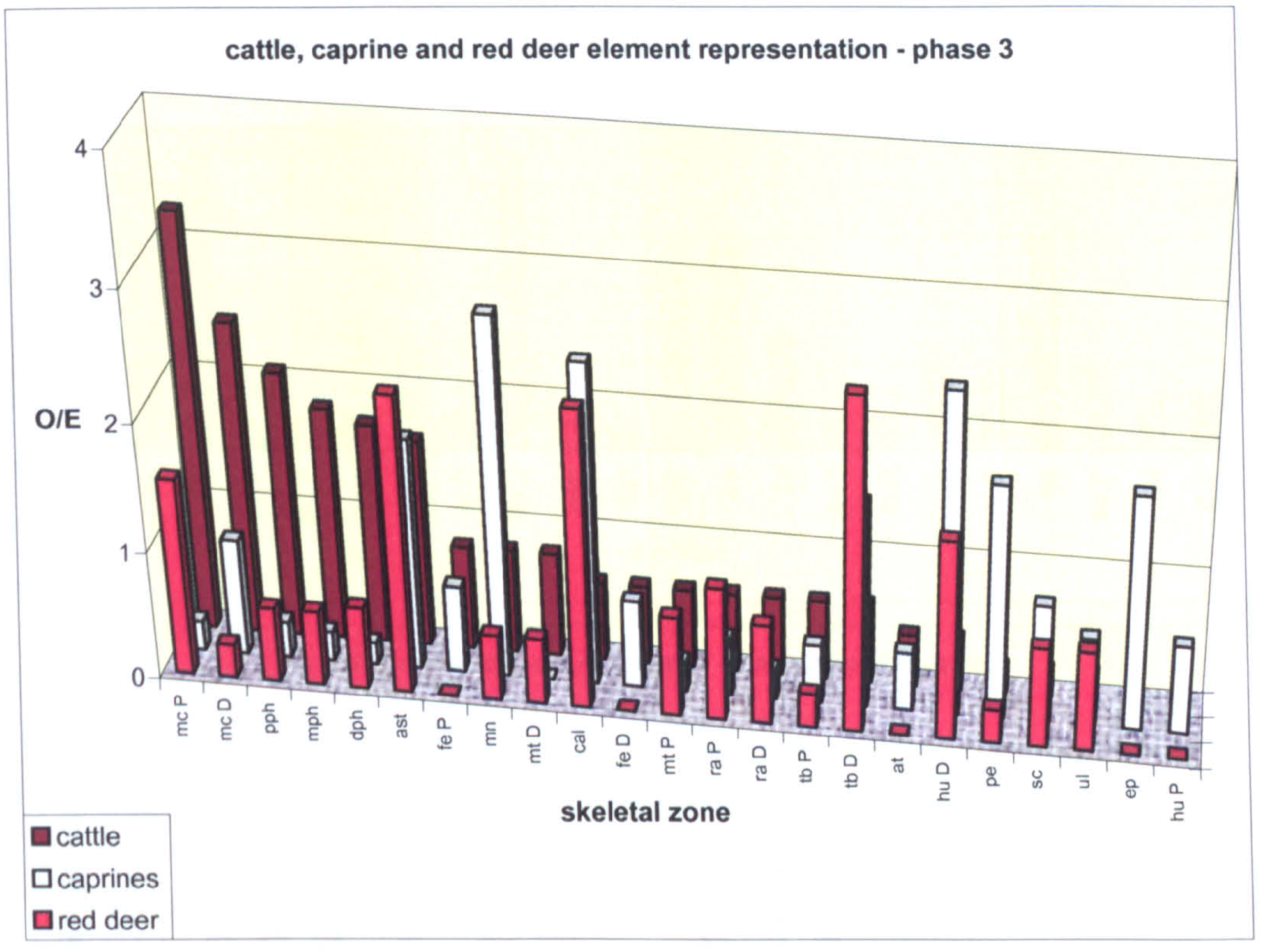


Figure 4.17: element representation of the three main taxa from Bostadh



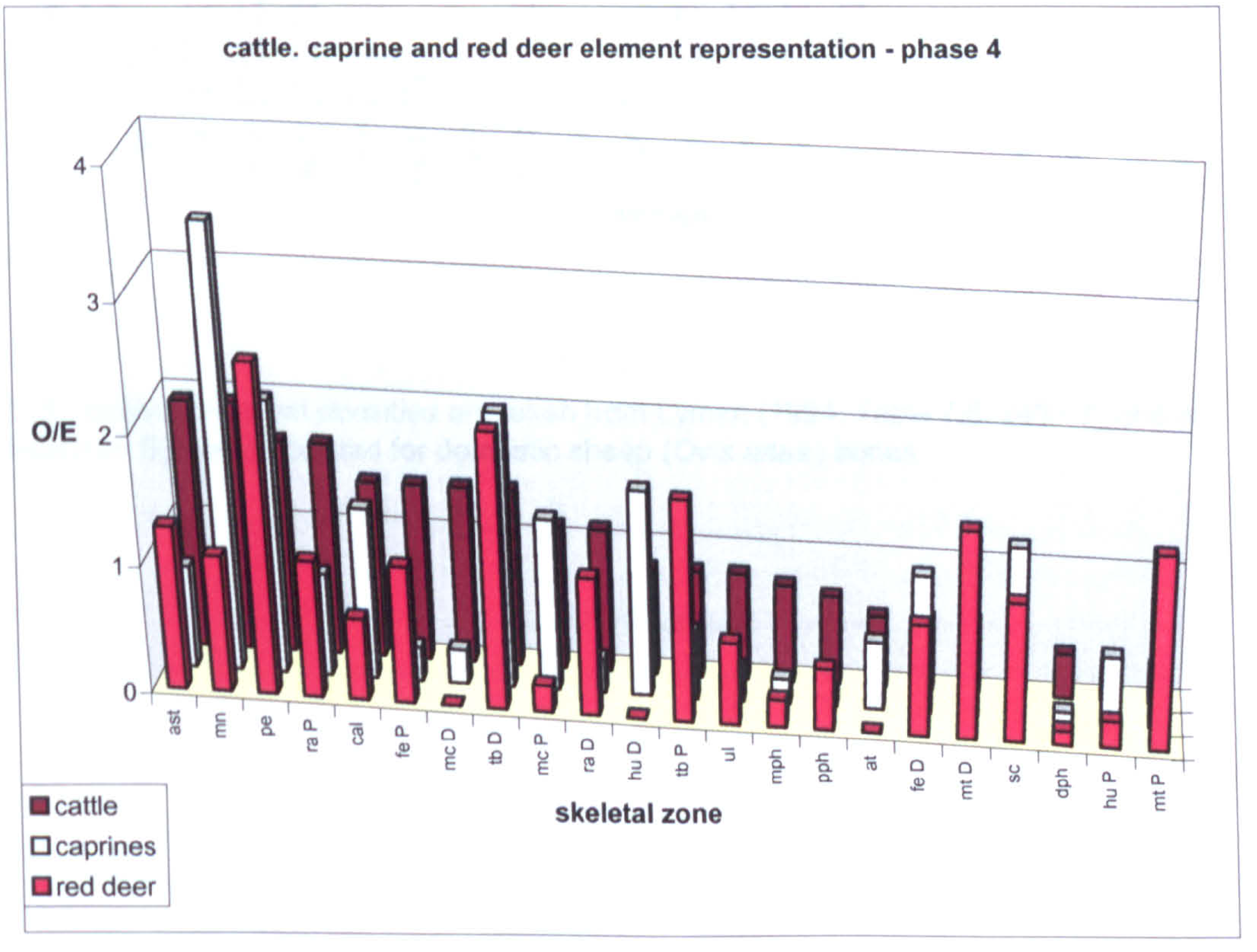
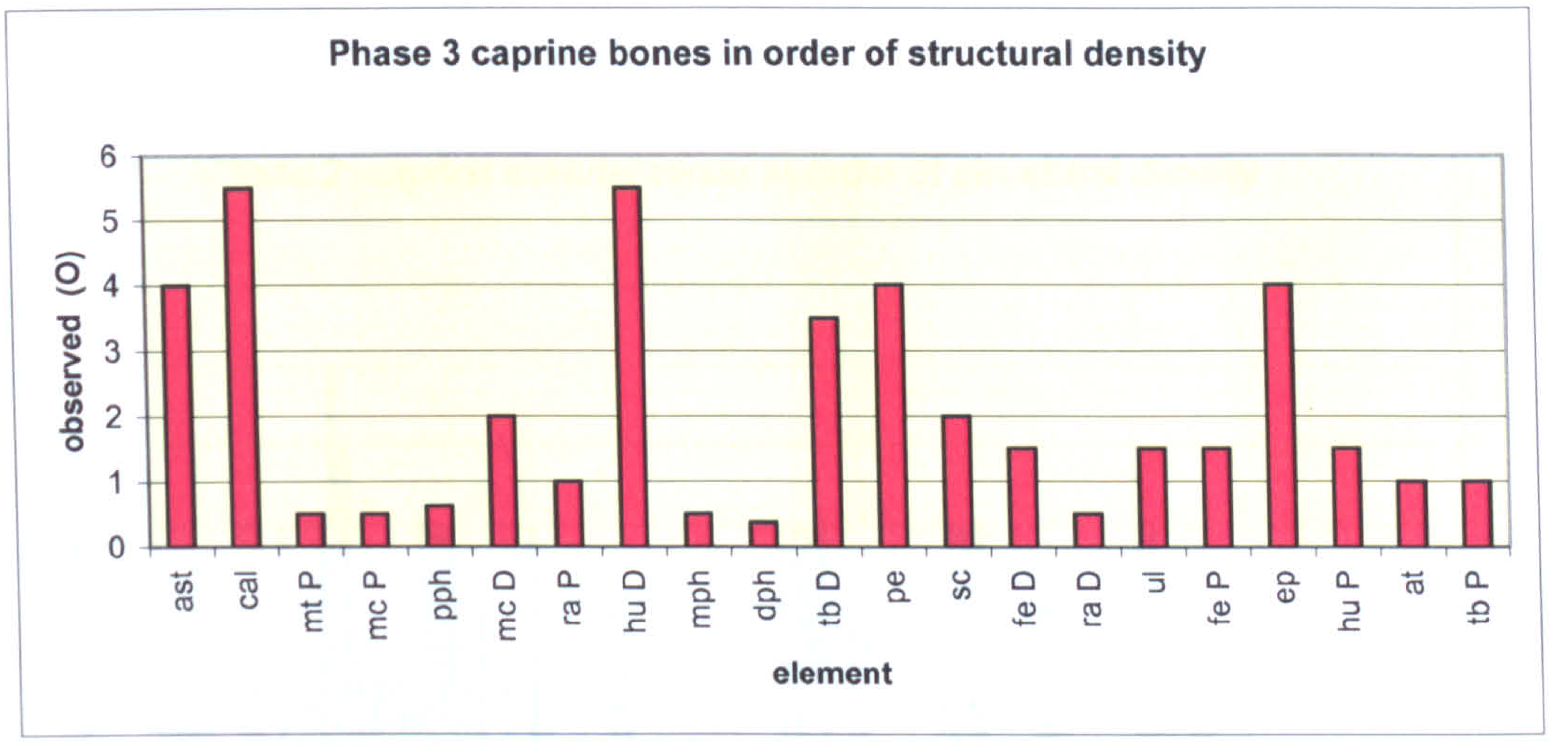
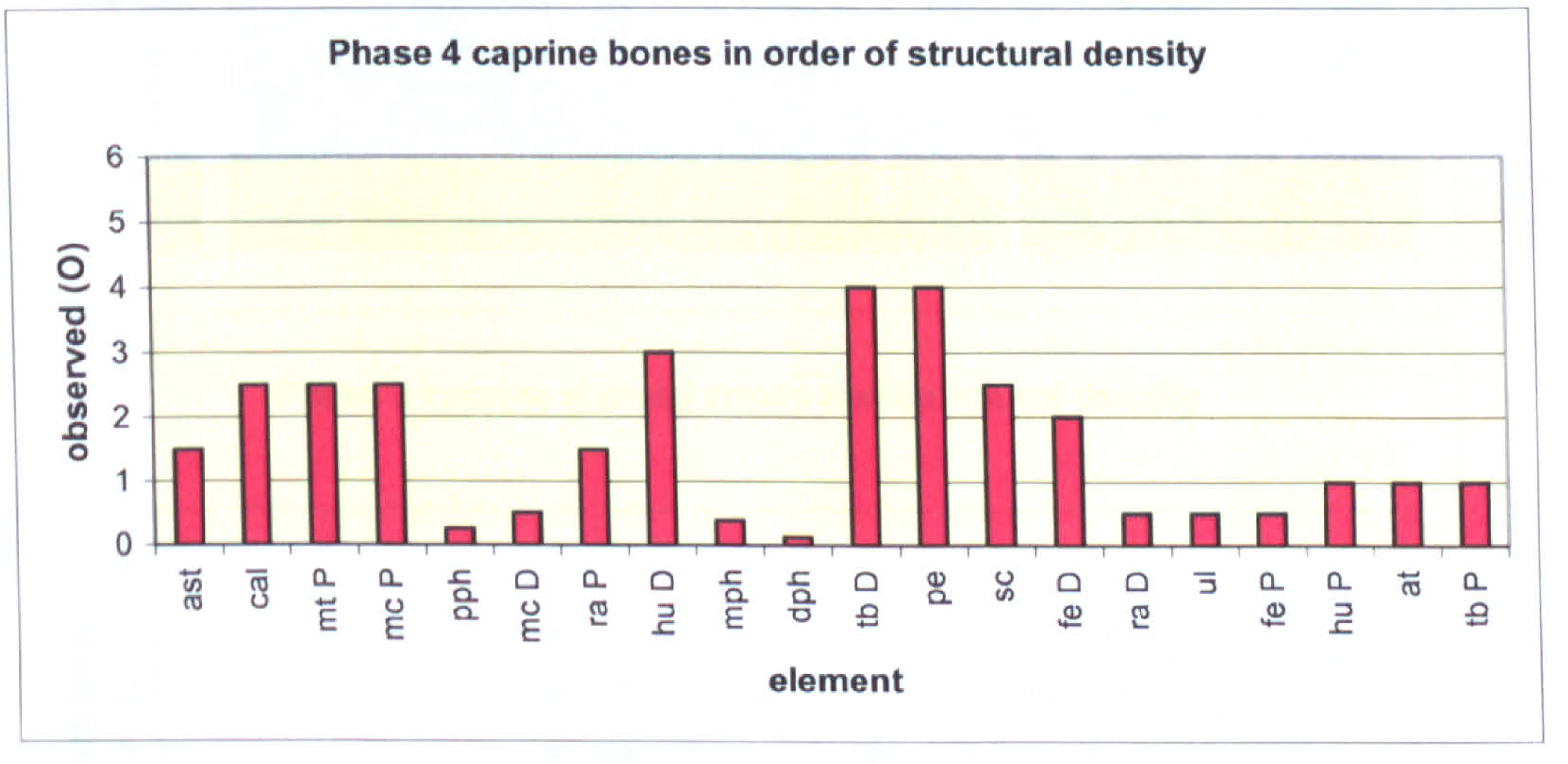


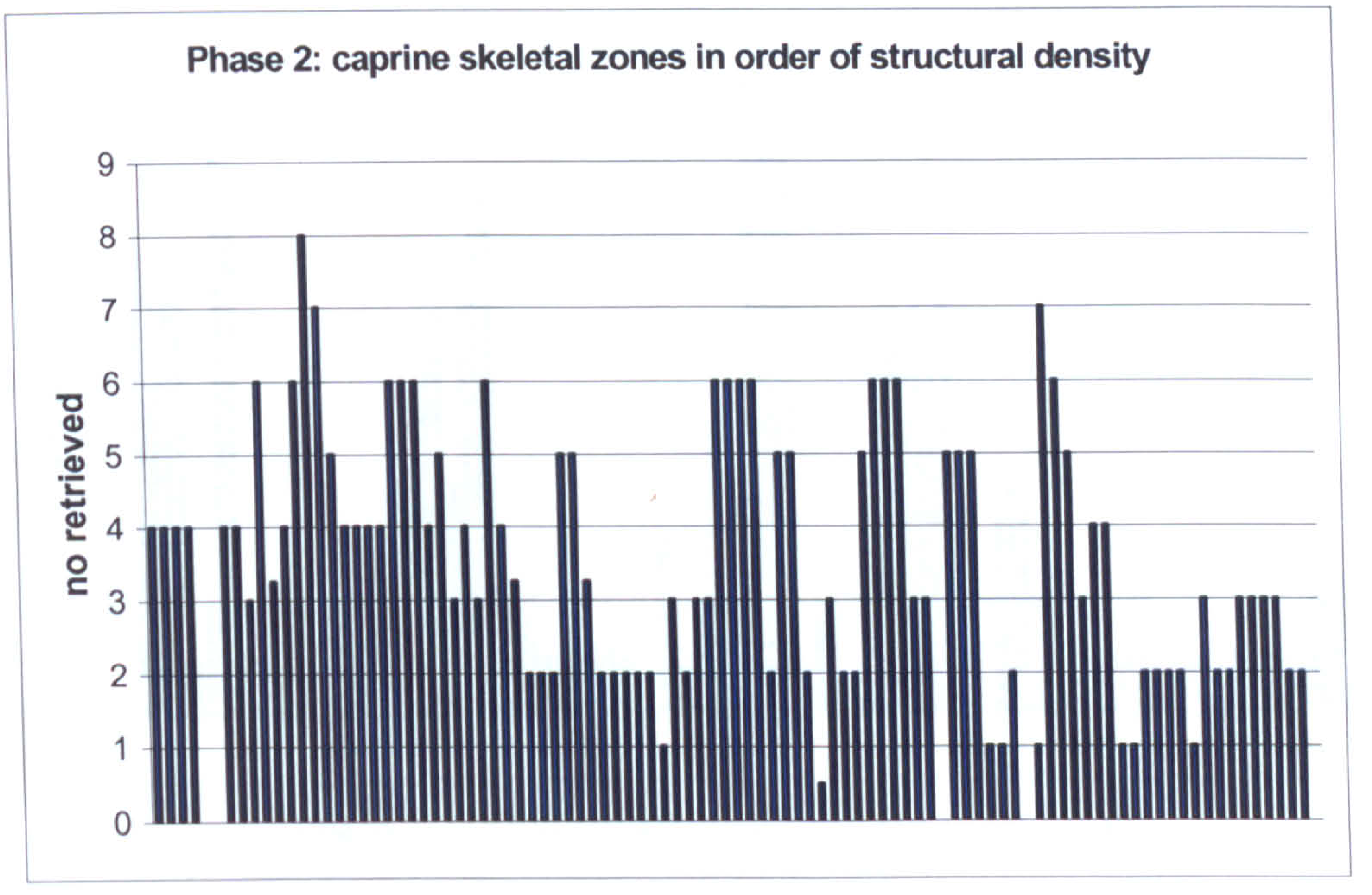
Figure 4.18: Bostadh: Caprine bones in structural density order





N.B. relative structural densities are taken from Lyman (1994: Table 7.6, 246 - 7) and are based on figures calculated for domestic sheep (*Ovis aries*) bones

Figure 4.19: Structural density of caprine skeletal zones retrieved from phase 2 at Bostadh



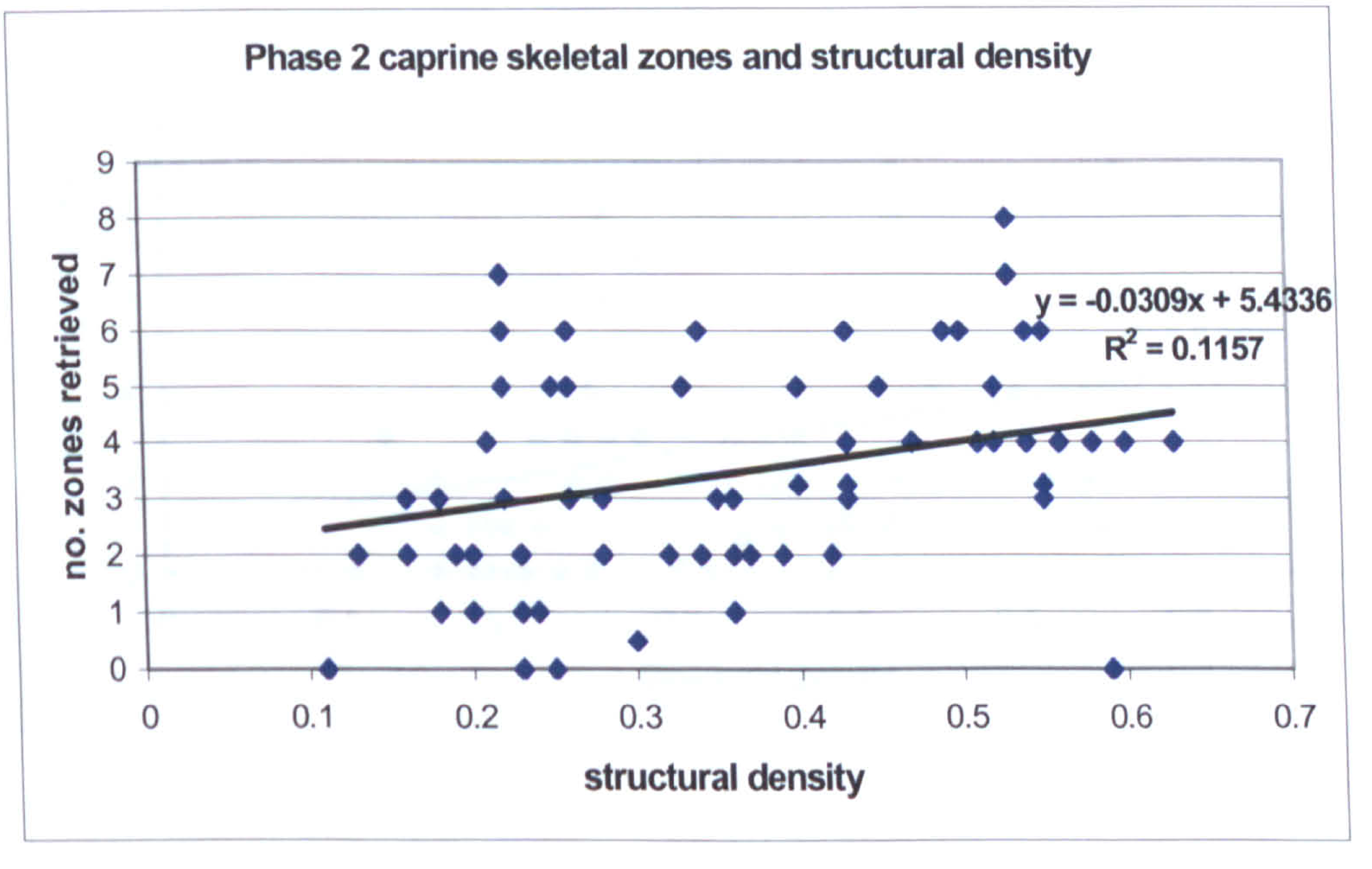
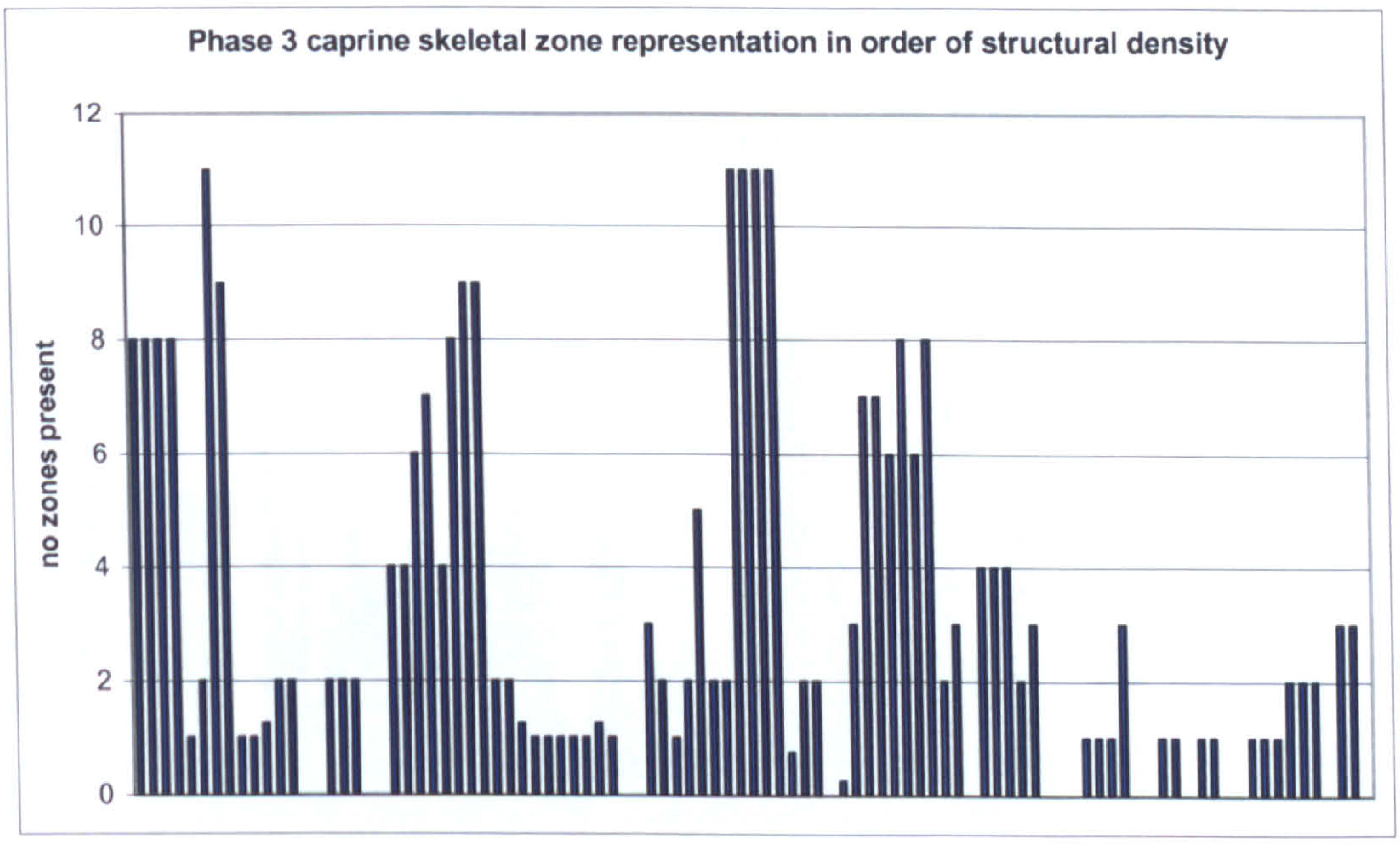


Figure 4.20: Structural density of caprine skeletal zones - phase 3 Bostadh



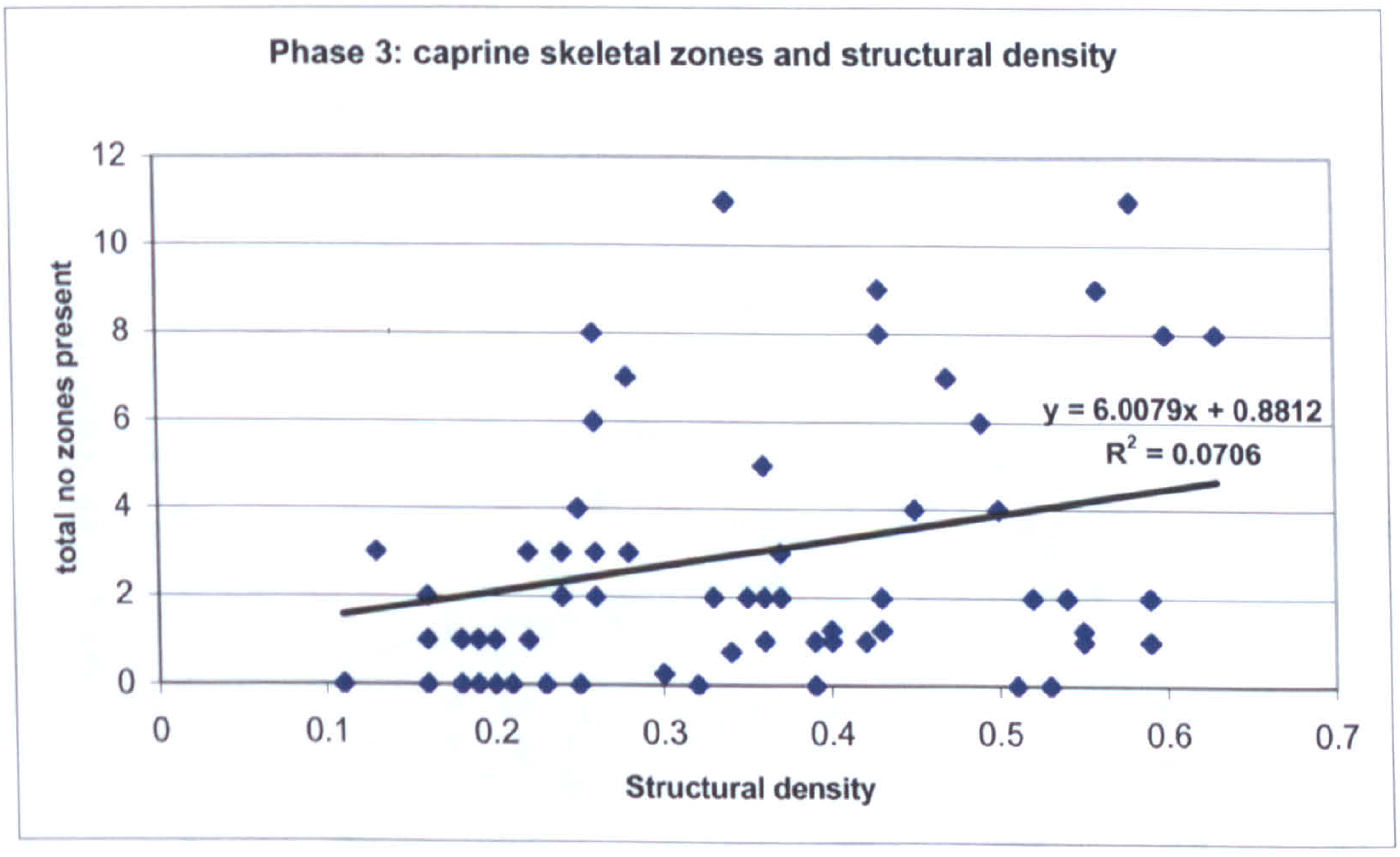
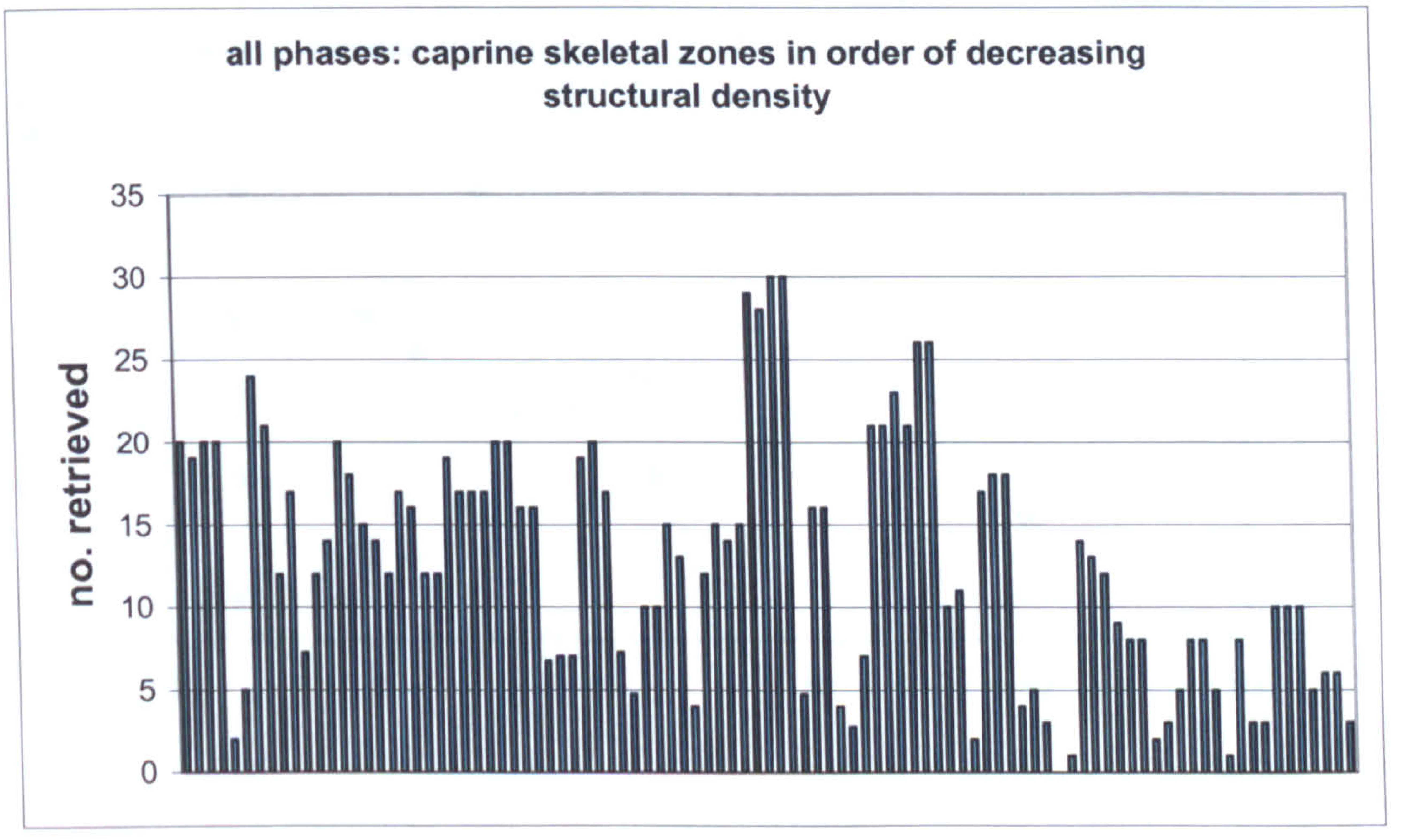


Figure 4.21: Structural density of caprine skeletal zones - Bostadh whole site



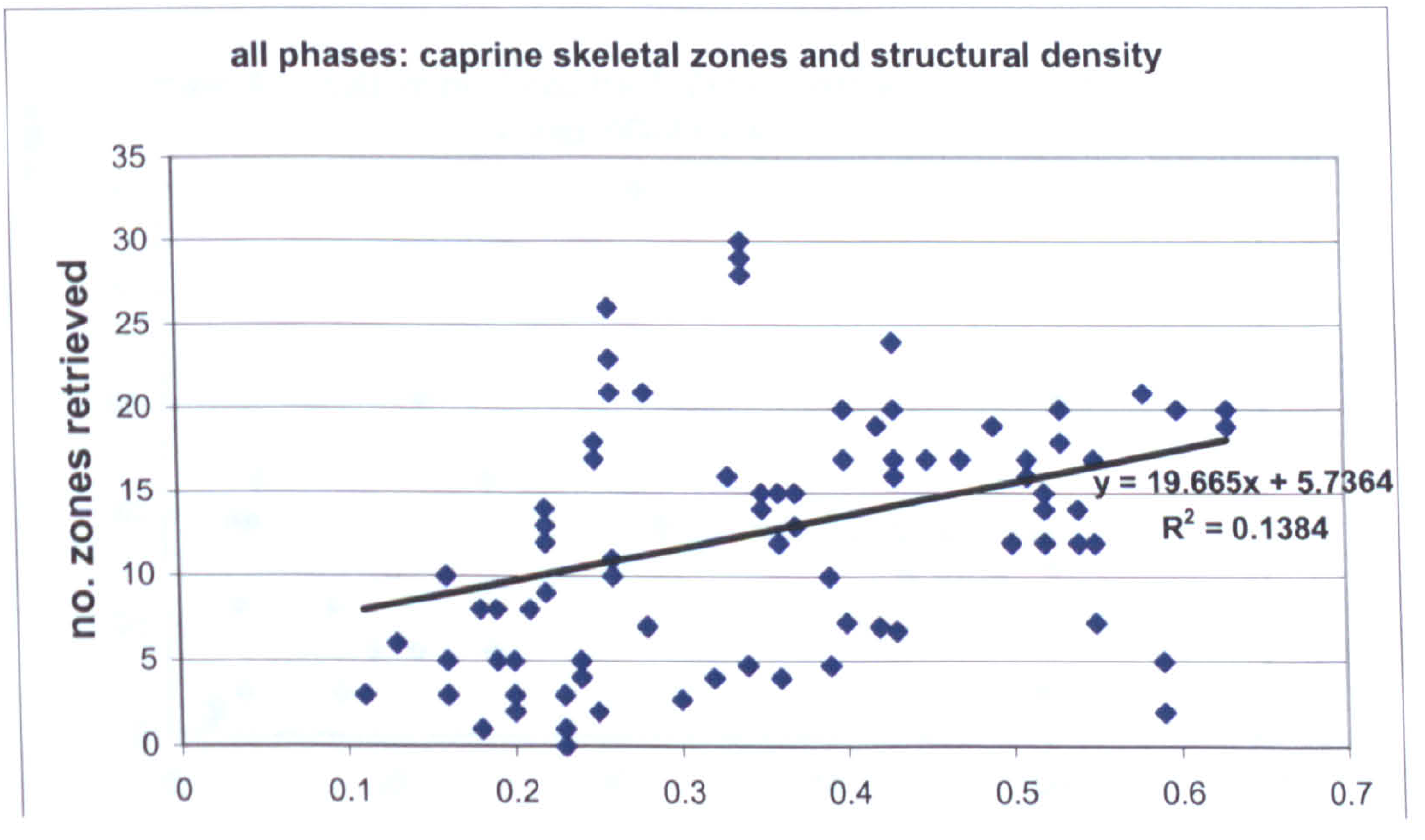
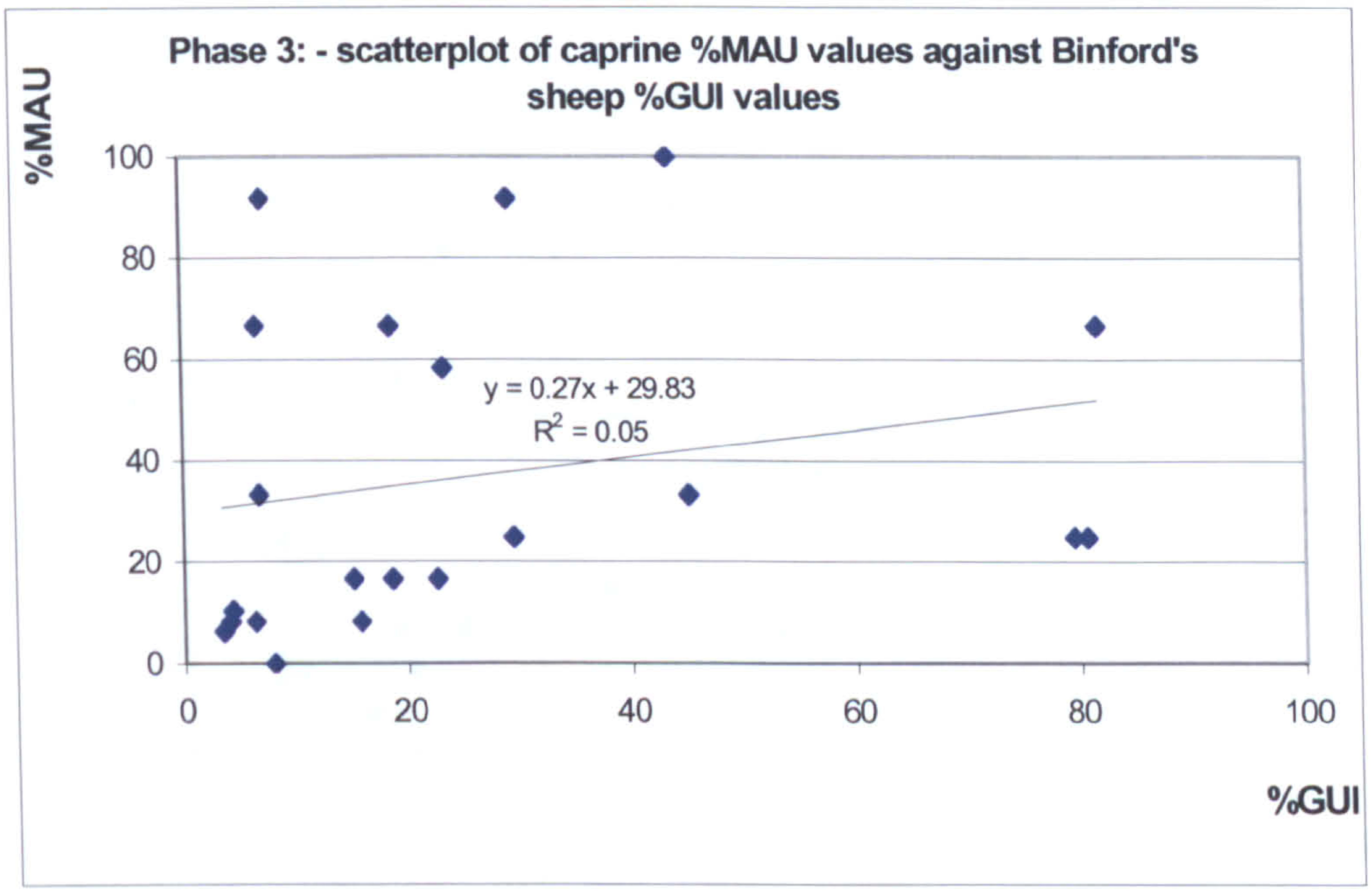


Figure 4.22: General utility indices for caprines in Phases 3 and 4 at Bostadh



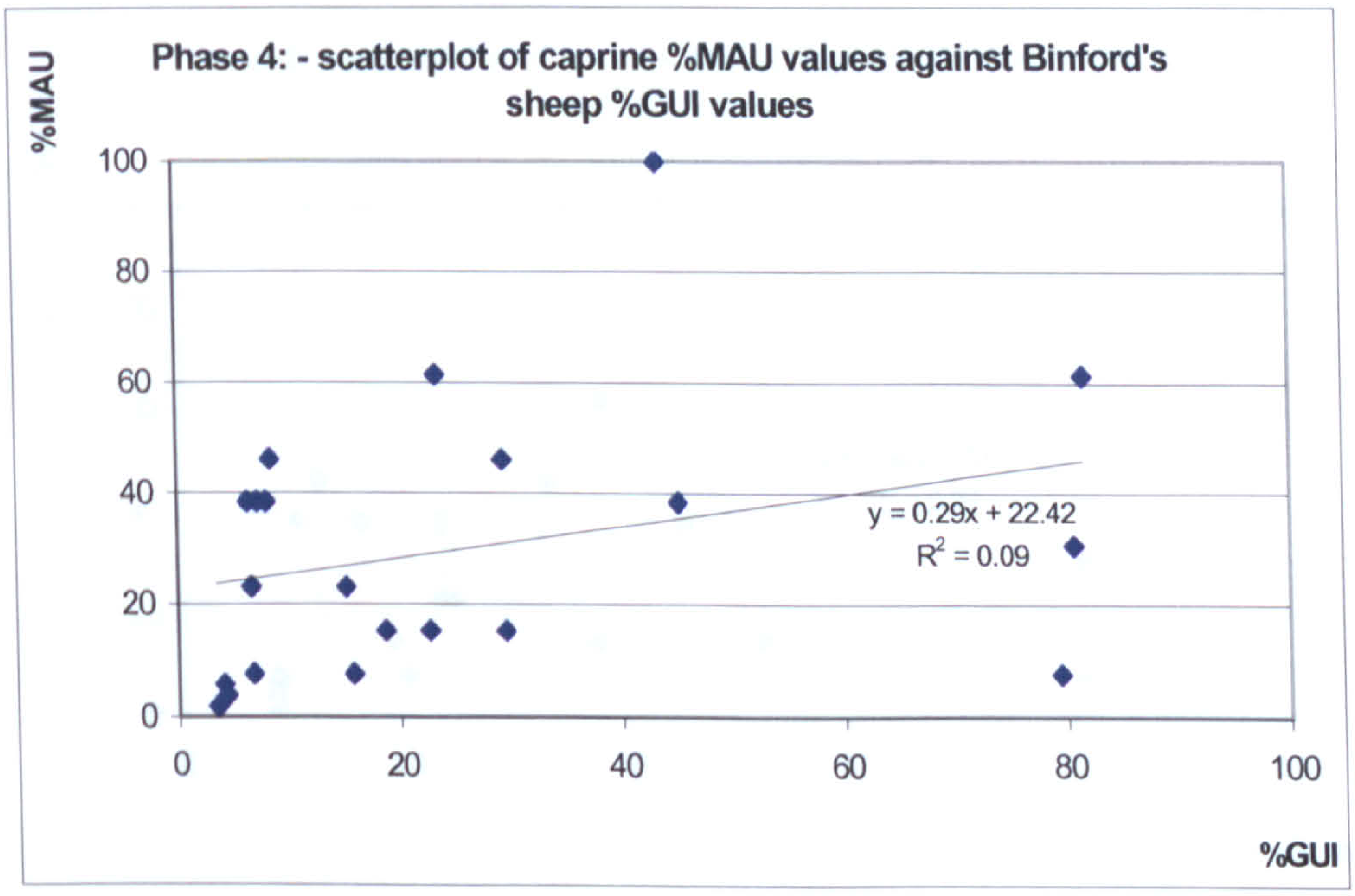
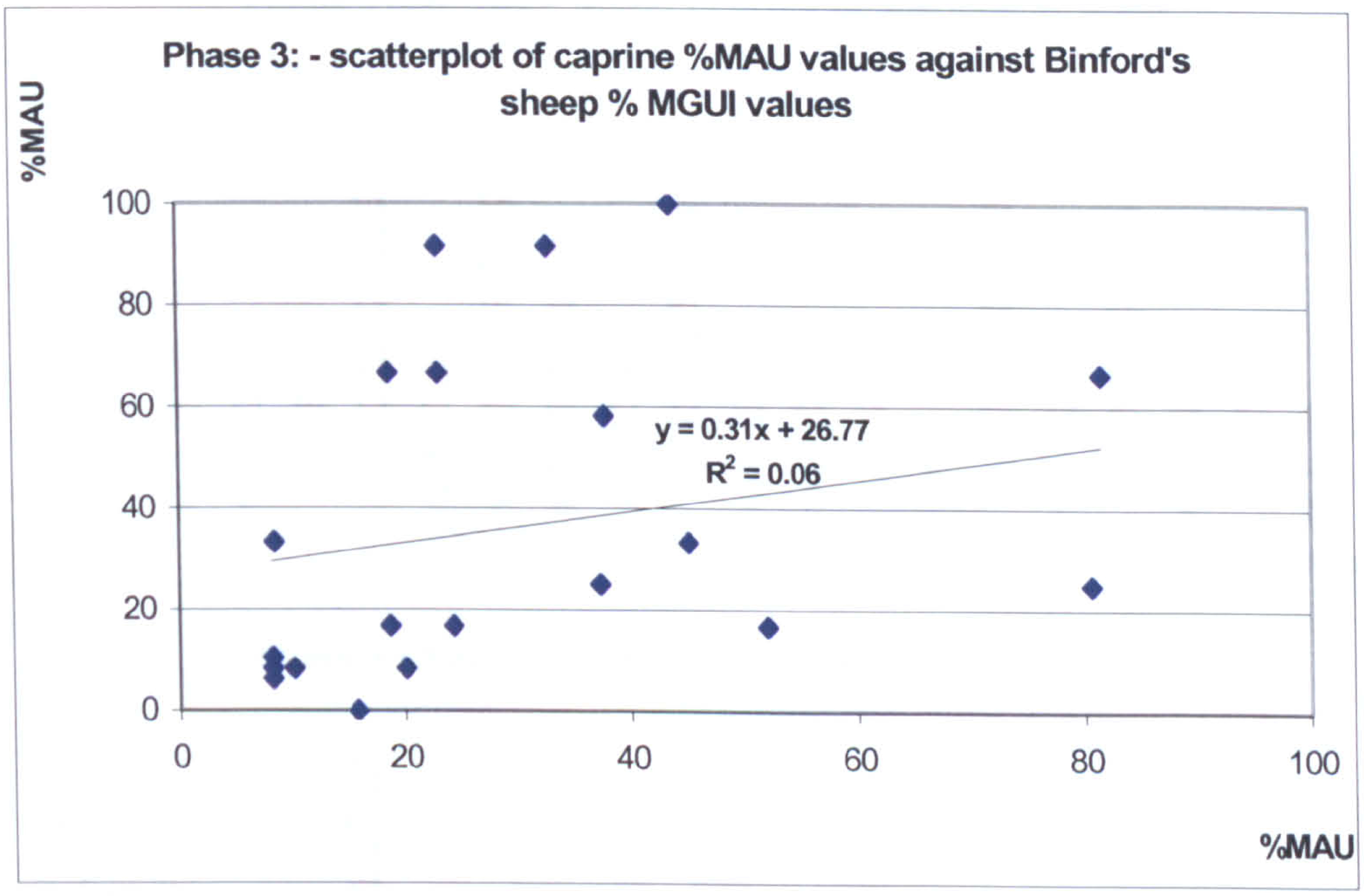


Figure 4.23: Modified general utility indices for caprines in Phases 3 and 4 at Bostadh



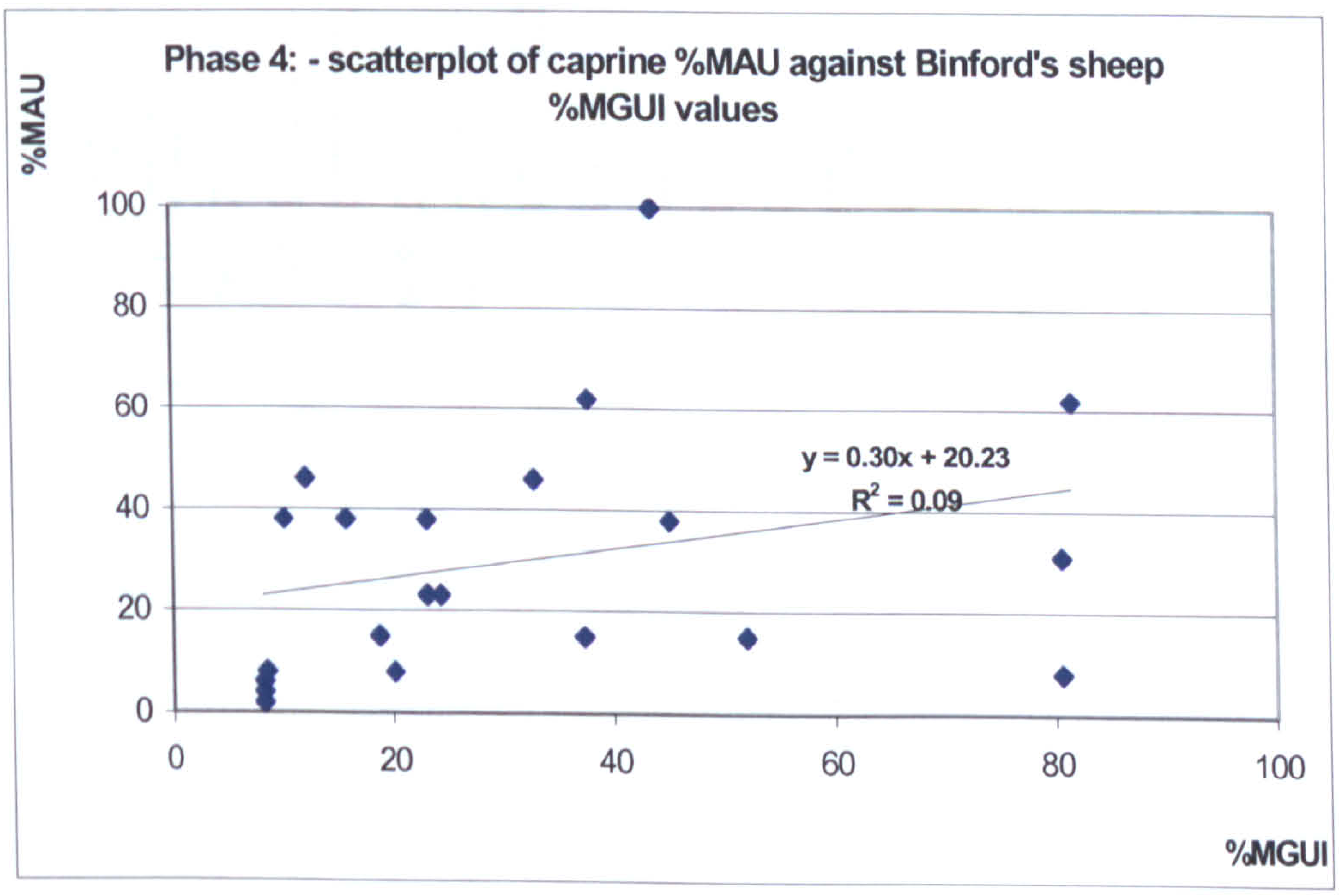
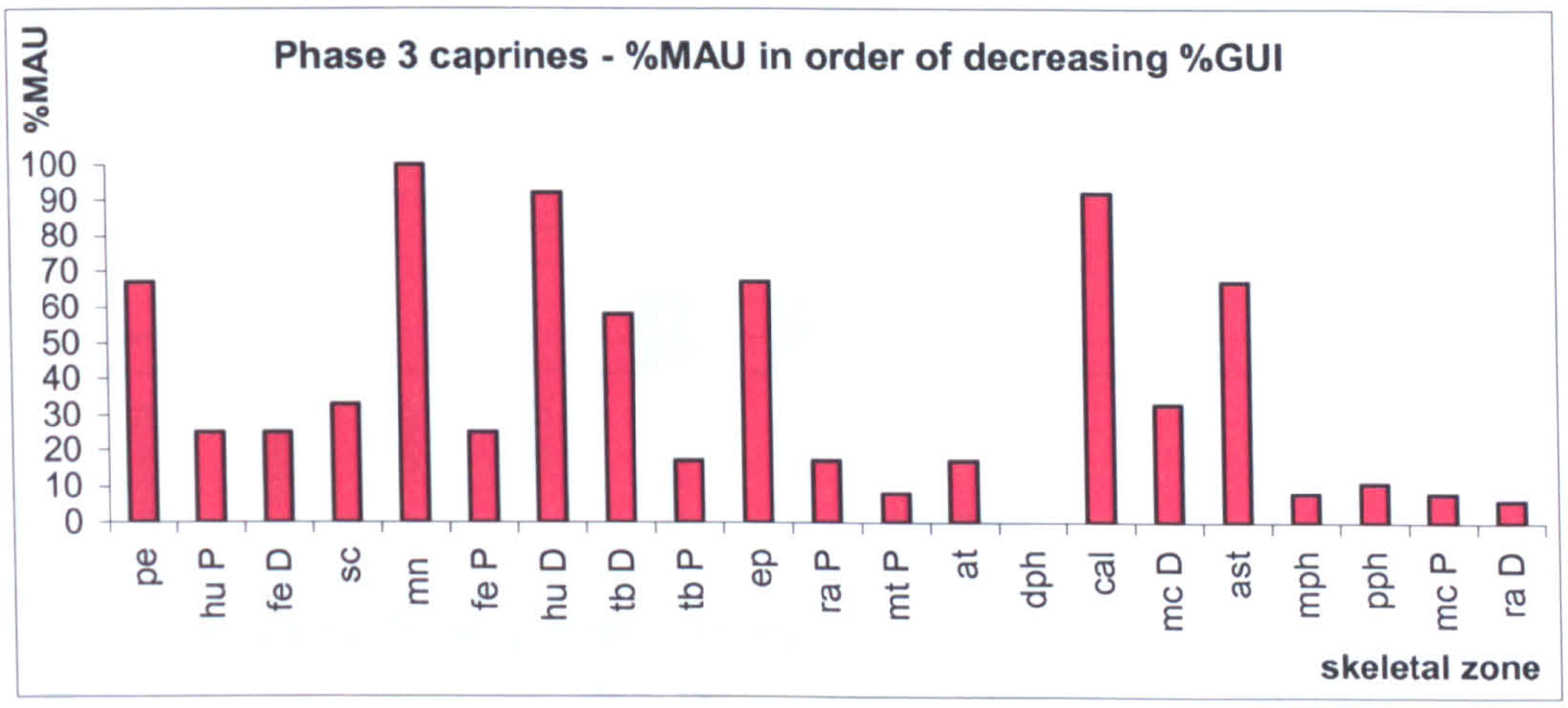


Figure 4.24: Caprine skeletal zones in order of decreasing %GUI for Bostadh



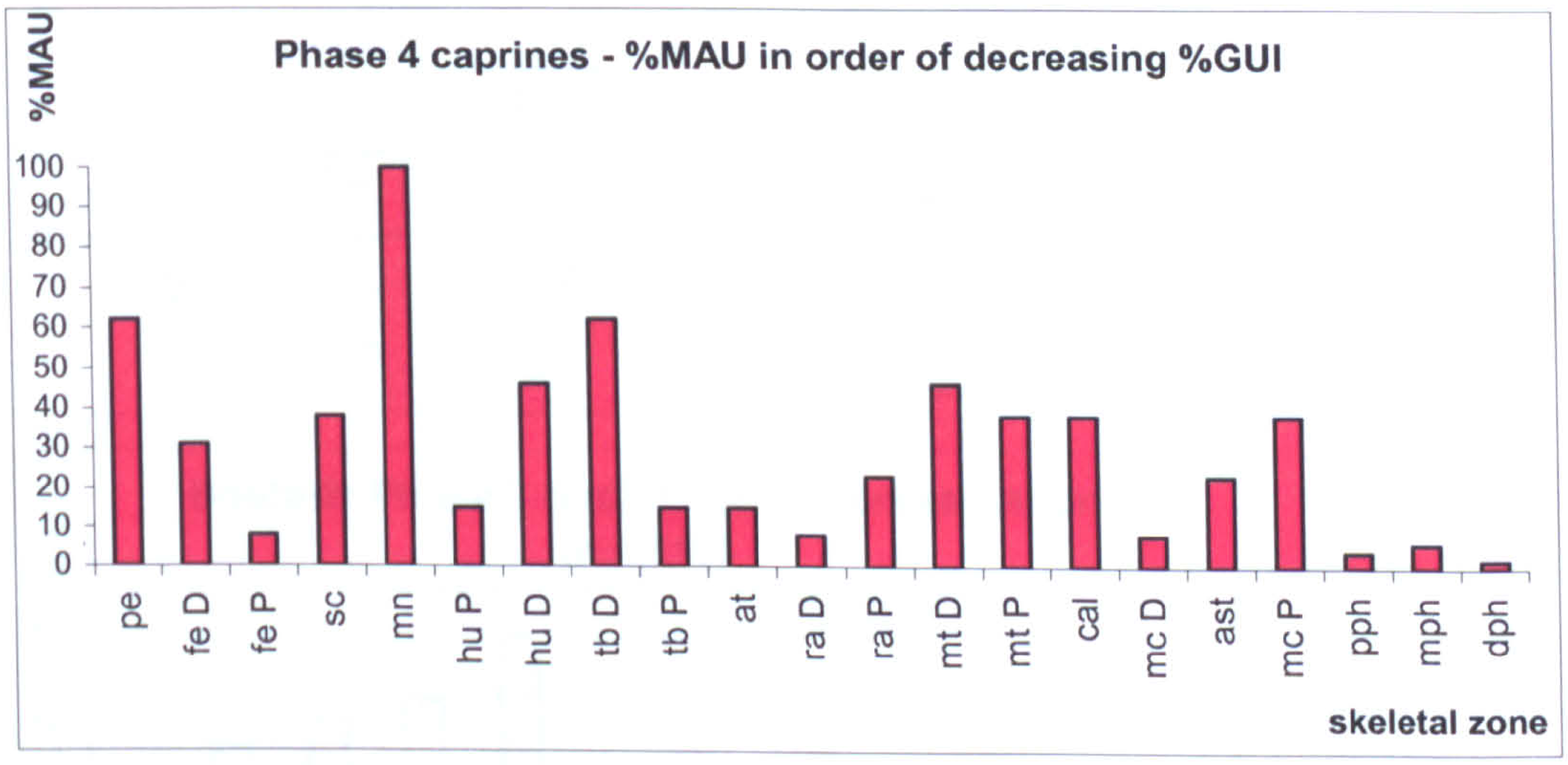


Figure 4.25: Bird bone element representation at Bostadh

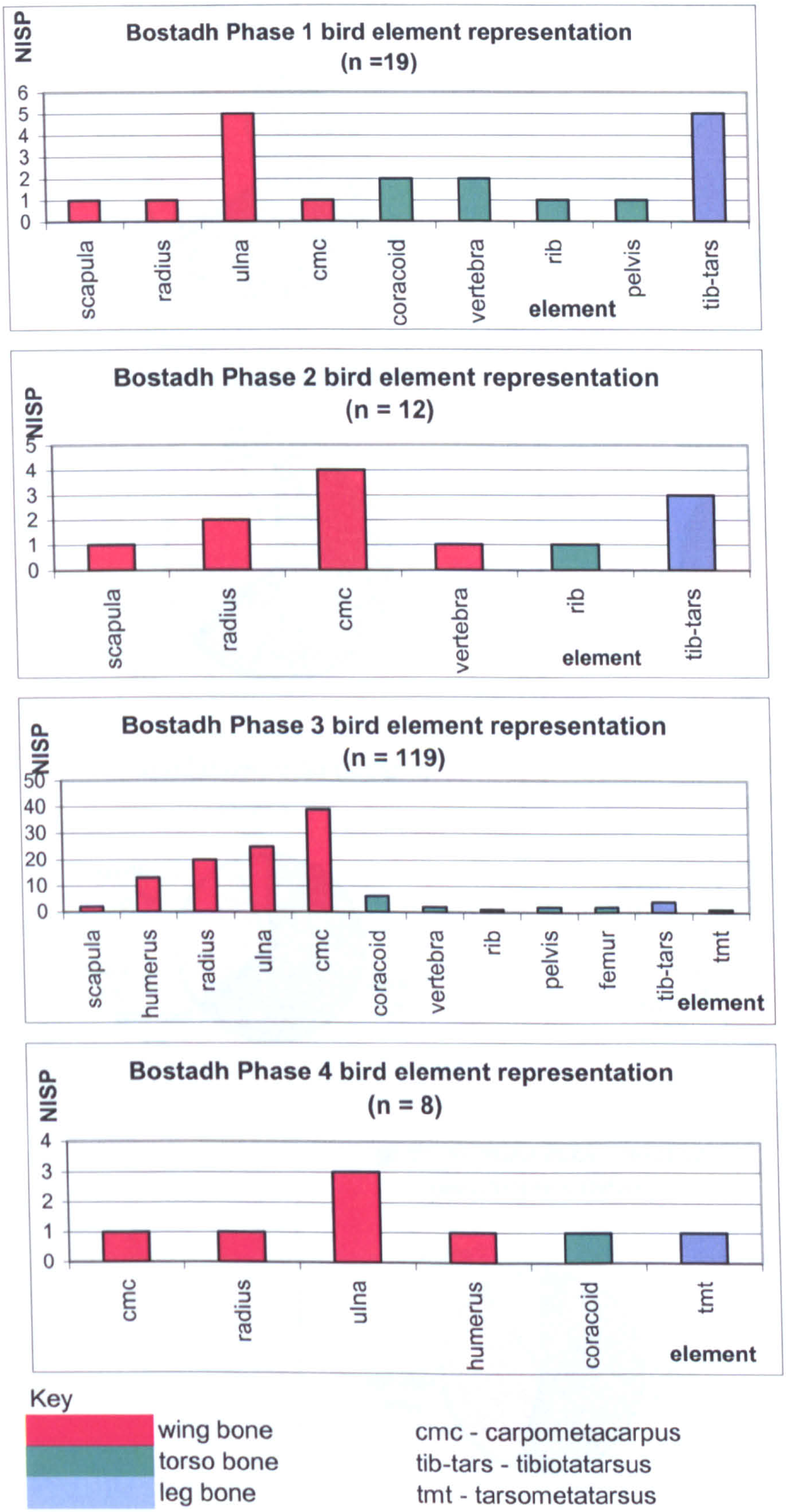


Figure 5.1: relative proportions of species at Beirgh

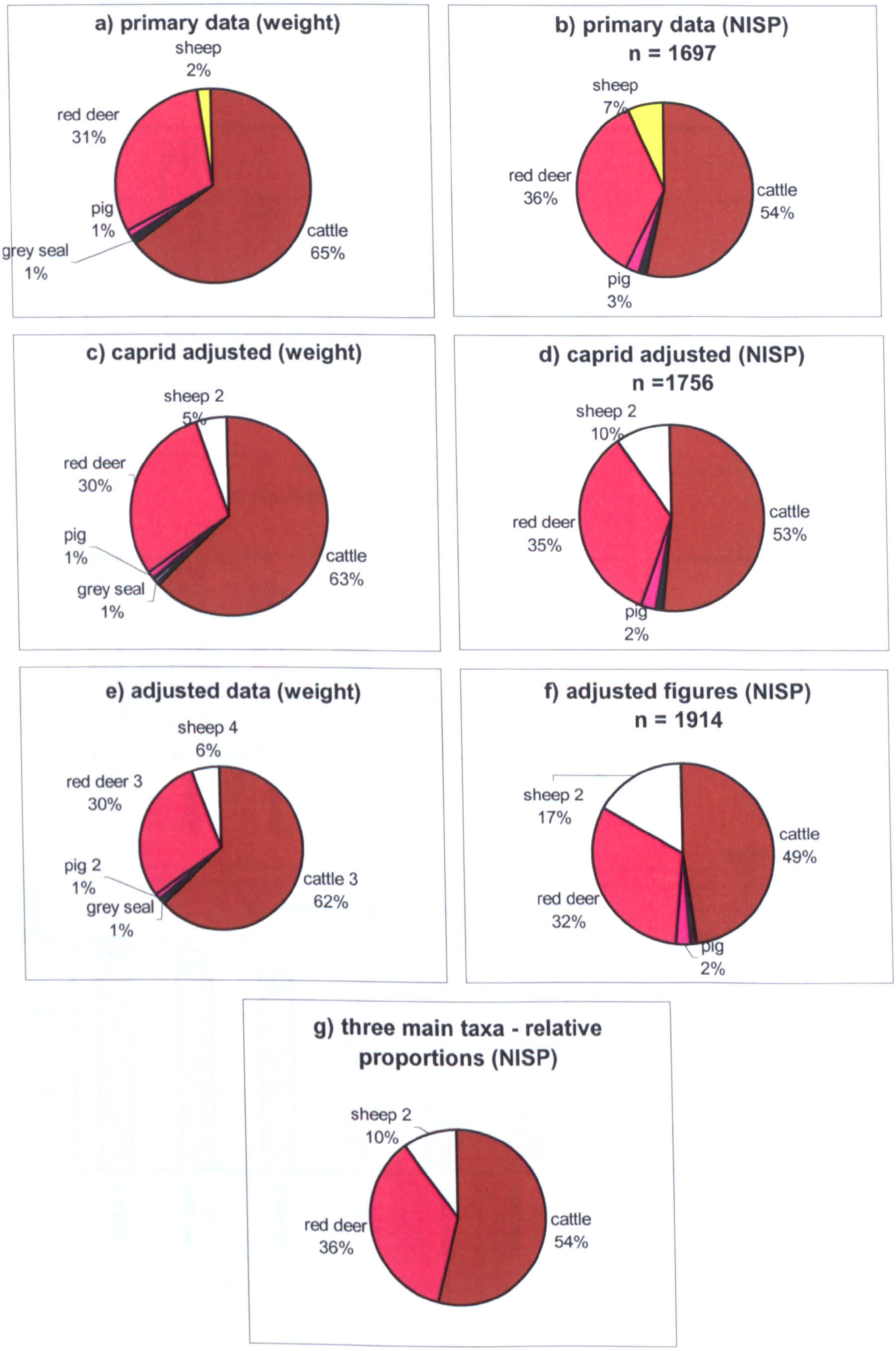


Figure 5.2: Beirgh: species representation (NISP) figures
N.B. note logarithmic scale

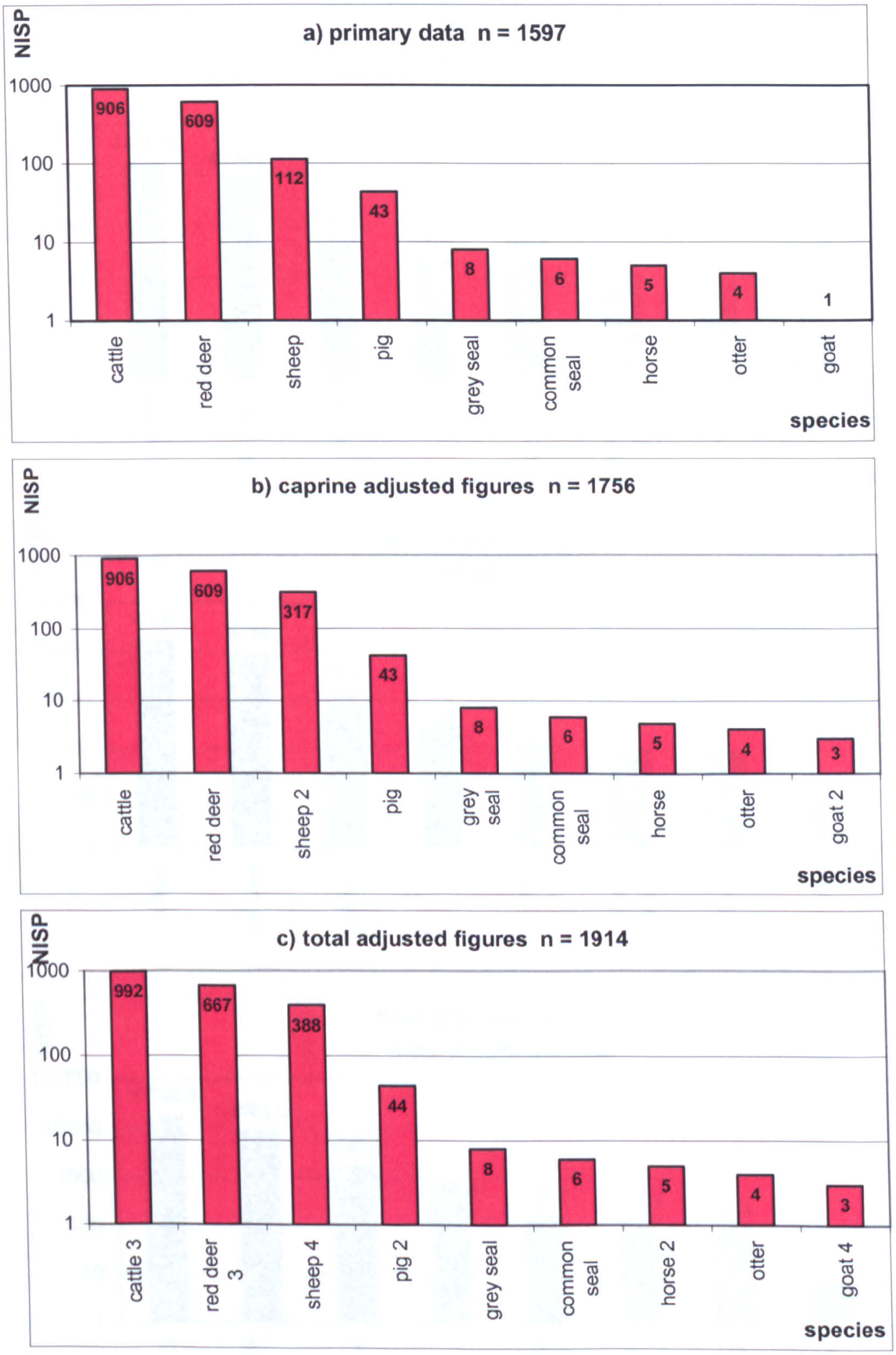


Figure 5.3: Beirgh: species representation (weight (g)) figures N.B. note logarithmic scale

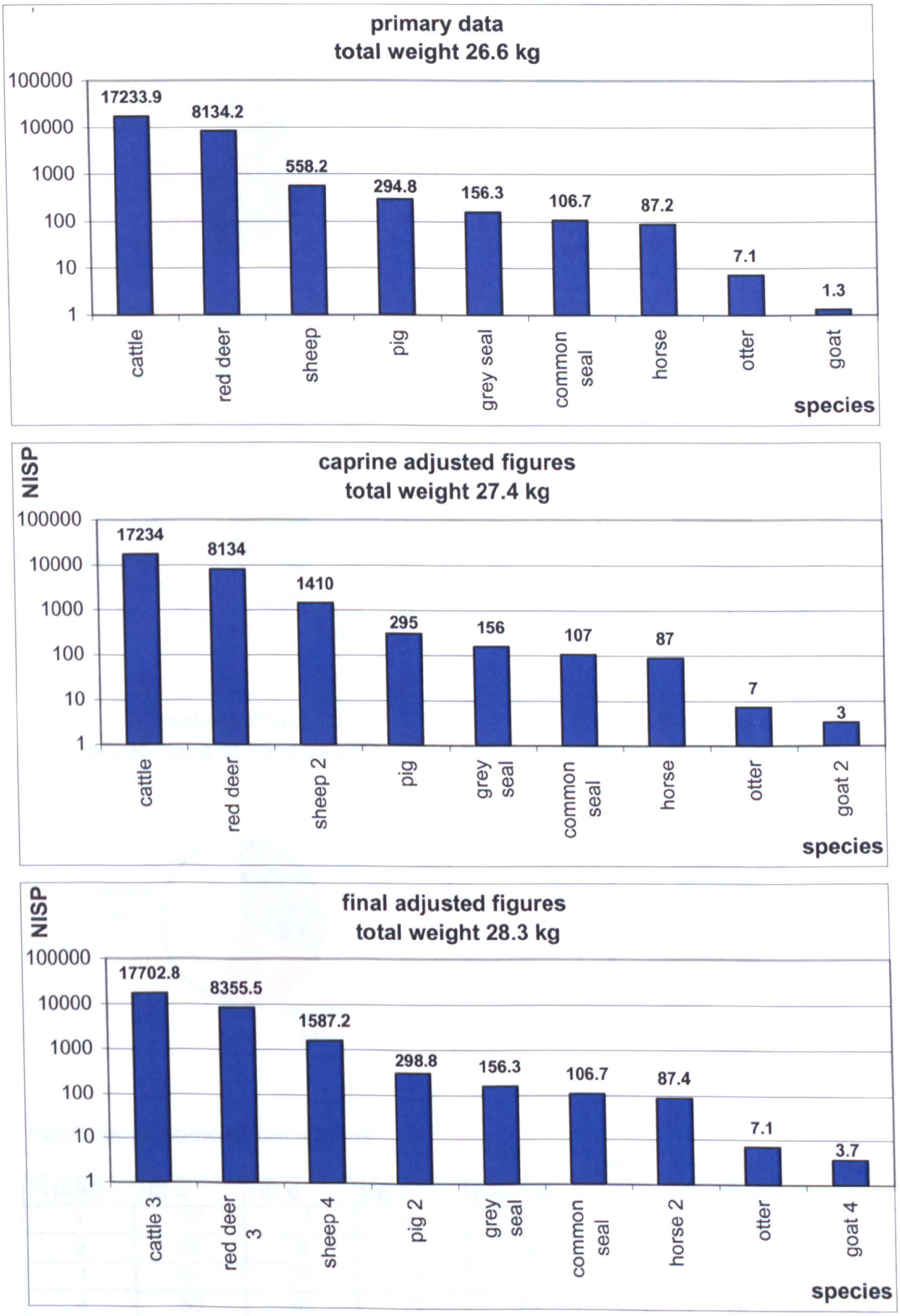
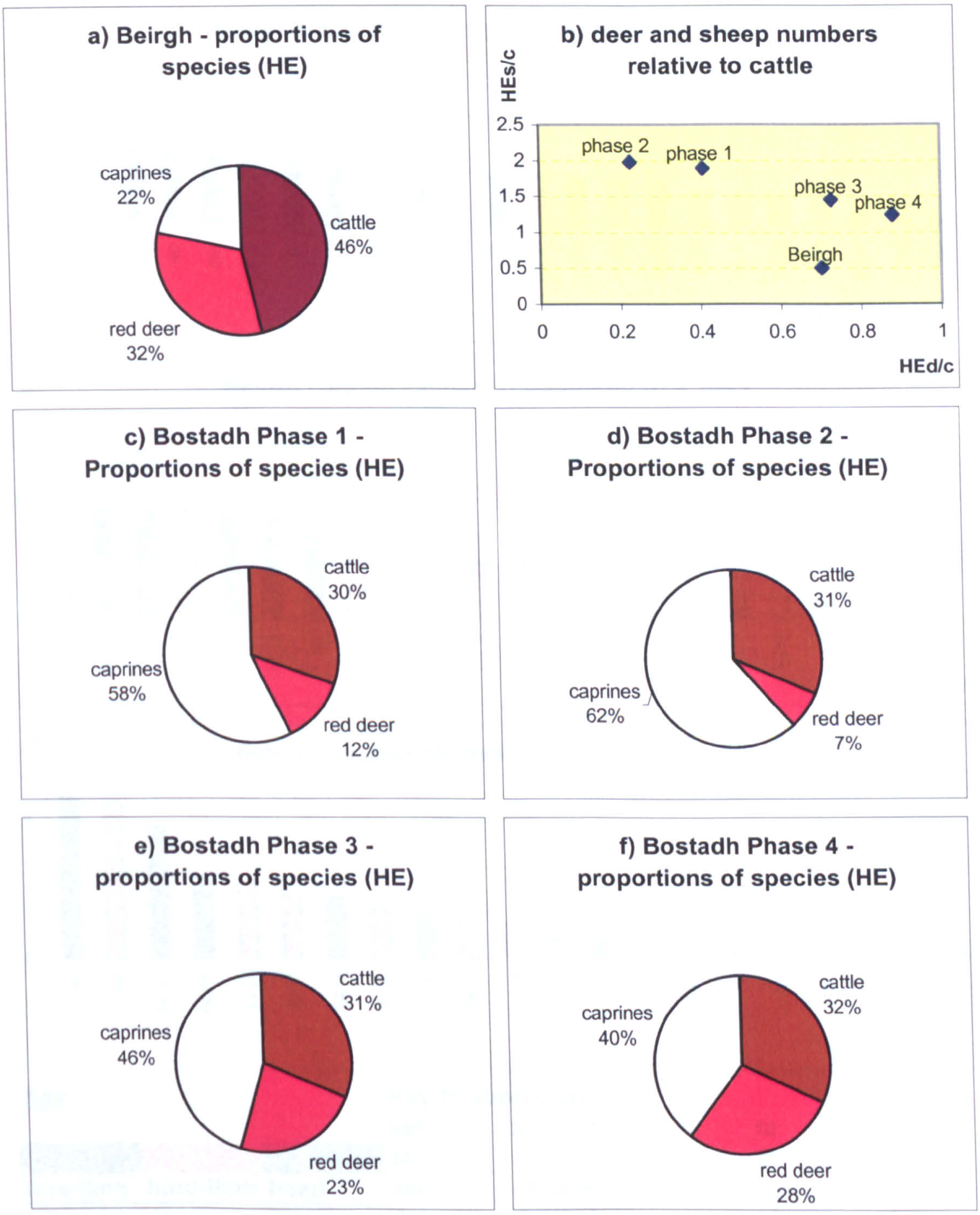


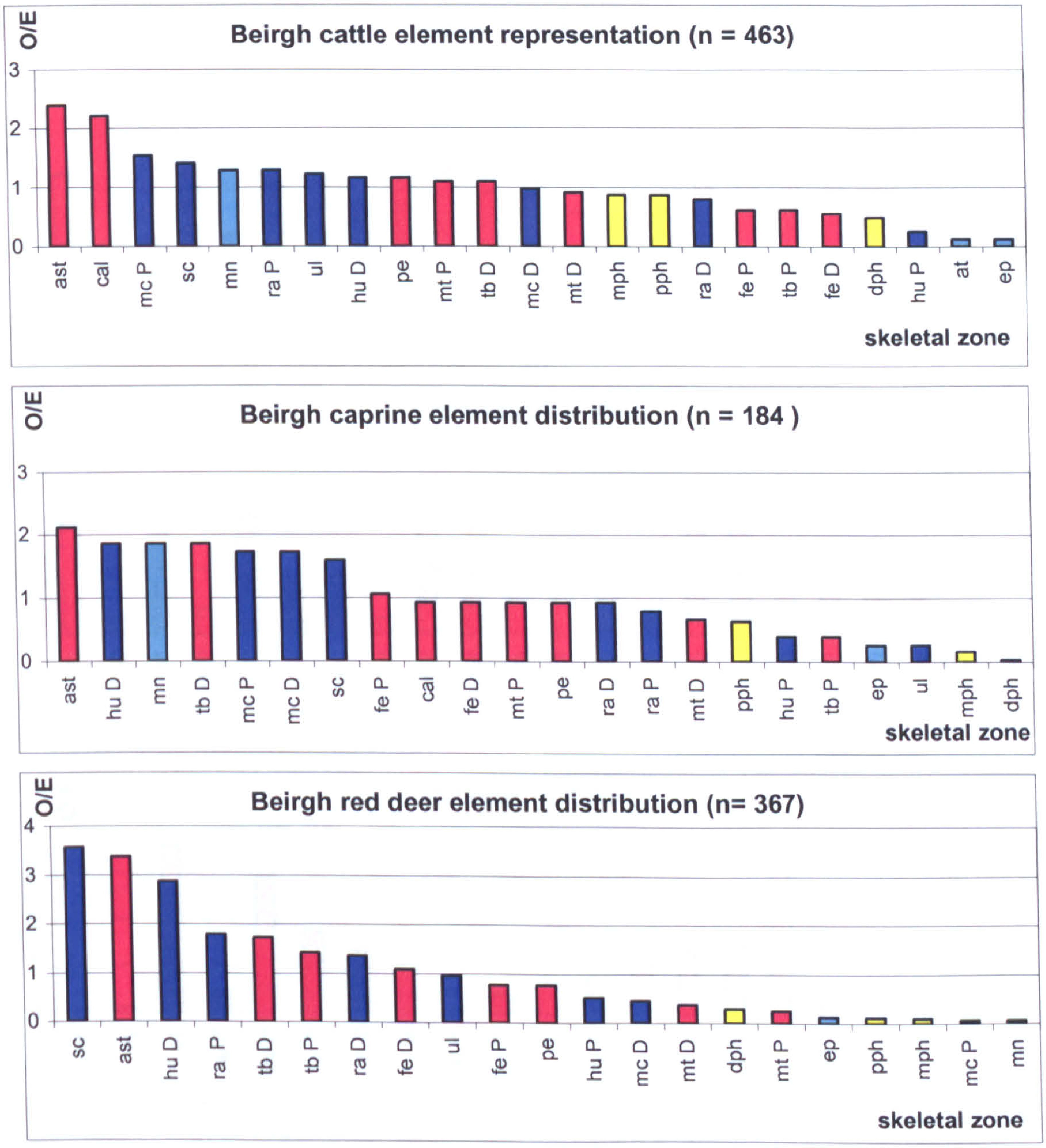
Figure 5.4: the proportions of species (homologous elements)



Homologous elements calculations

					cattle	red deer	caprines
PHASE	HE c	HE d	HE s	total HE	%HE c	%HE d	%HE s
1	27	11	51	89	30.3	12.4	57.3
2	40	9	79	128	31.3	7.0	61.7
3	51	37	74	162	31.5	22.8	45.7
4	58	51	72	181	32.0	28.2	39.8
Beirgh	262	179	123	564	46.5	31.7	21.8

Figure 5.5: Beirgh element distribution figures in order of abundance



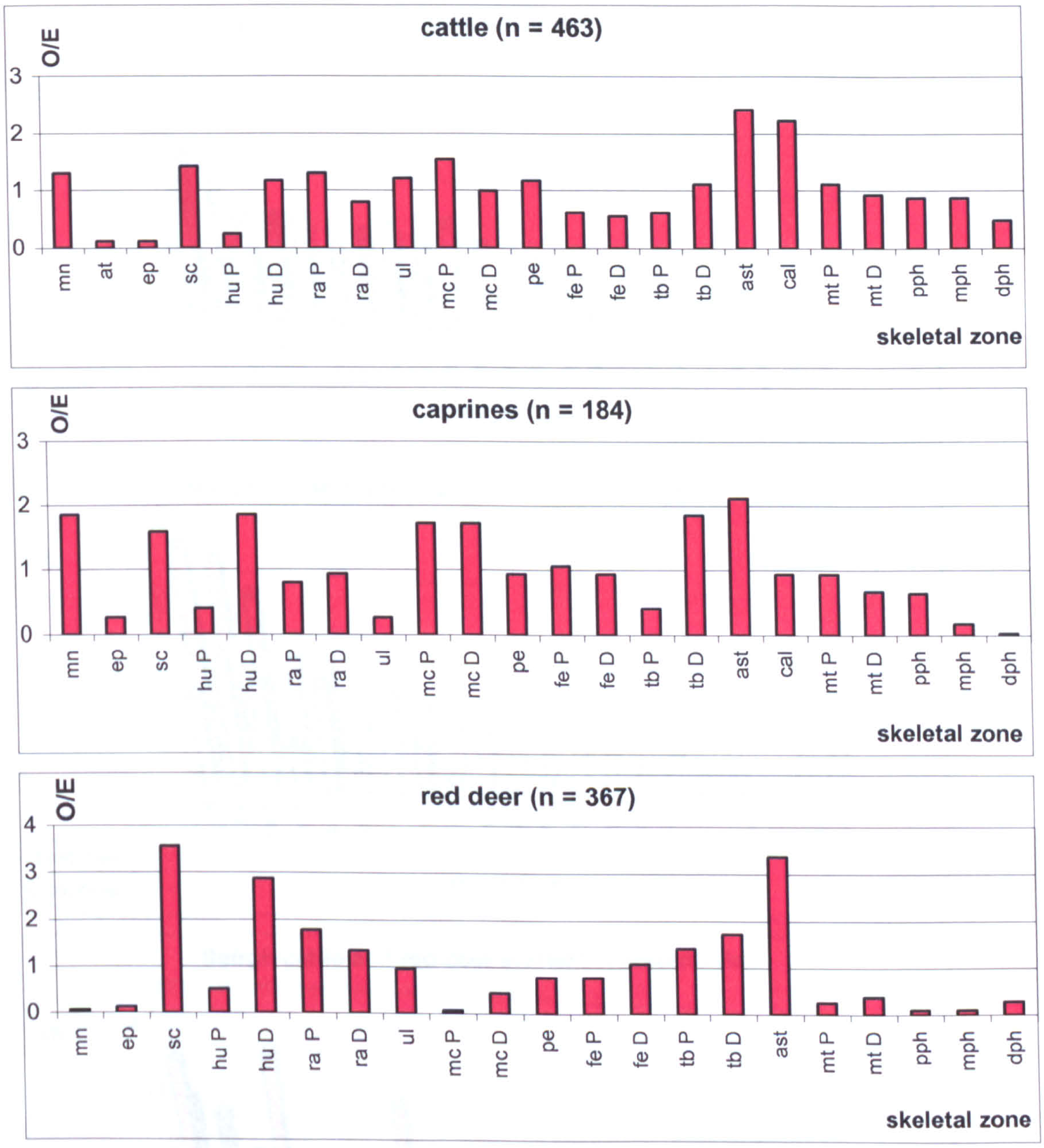
Key

fore-limb	hind-limb	head
sc	pe	mn
hu P	fe P	ep
hu D	fe D	at
ra P	tb P	
ra D	tb D	
ul	cal	**feet**
mc P	ast	pph
mc D	mt P	mph
	mt D	dph

Key to abbreviations

ast	astragalus	**ra**	radius
at	atlas	**tb**	tibia
cal	calcaneum	**sc**	scapula
dph	distal phalanx	**ul**	ulna
ep	epistropheus (axis)	**D**	distal
fe	femur	**P**	proximal
hu	humerus		
mc	metacarpal		
mn	mandible		
mph	middle phalanx		
mt	metatarsal		
pe	pelvis		
pph	proximal phalanx		

Figure 5.6: Beirgh element distribution figures in anatomical order



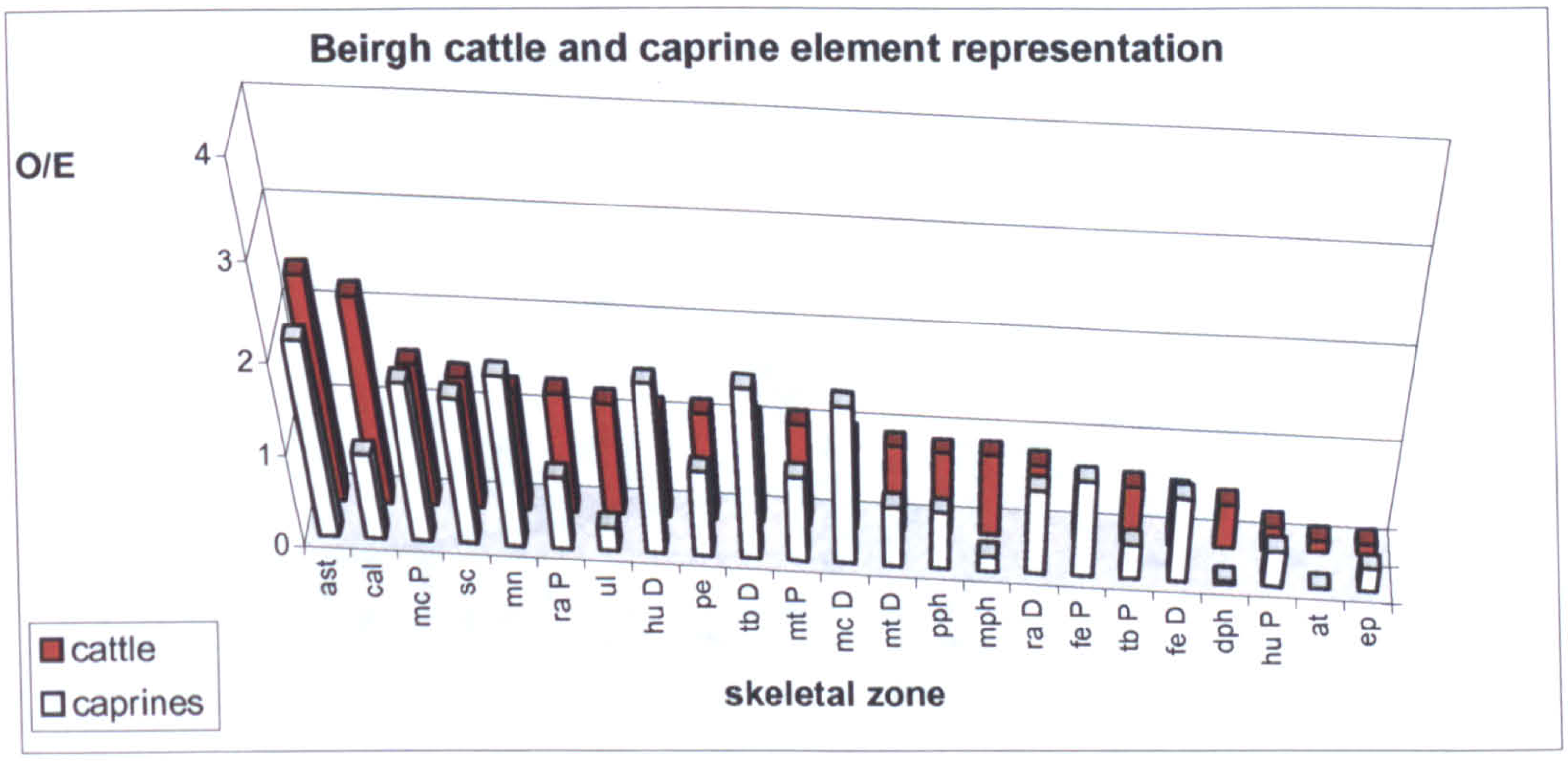
Key

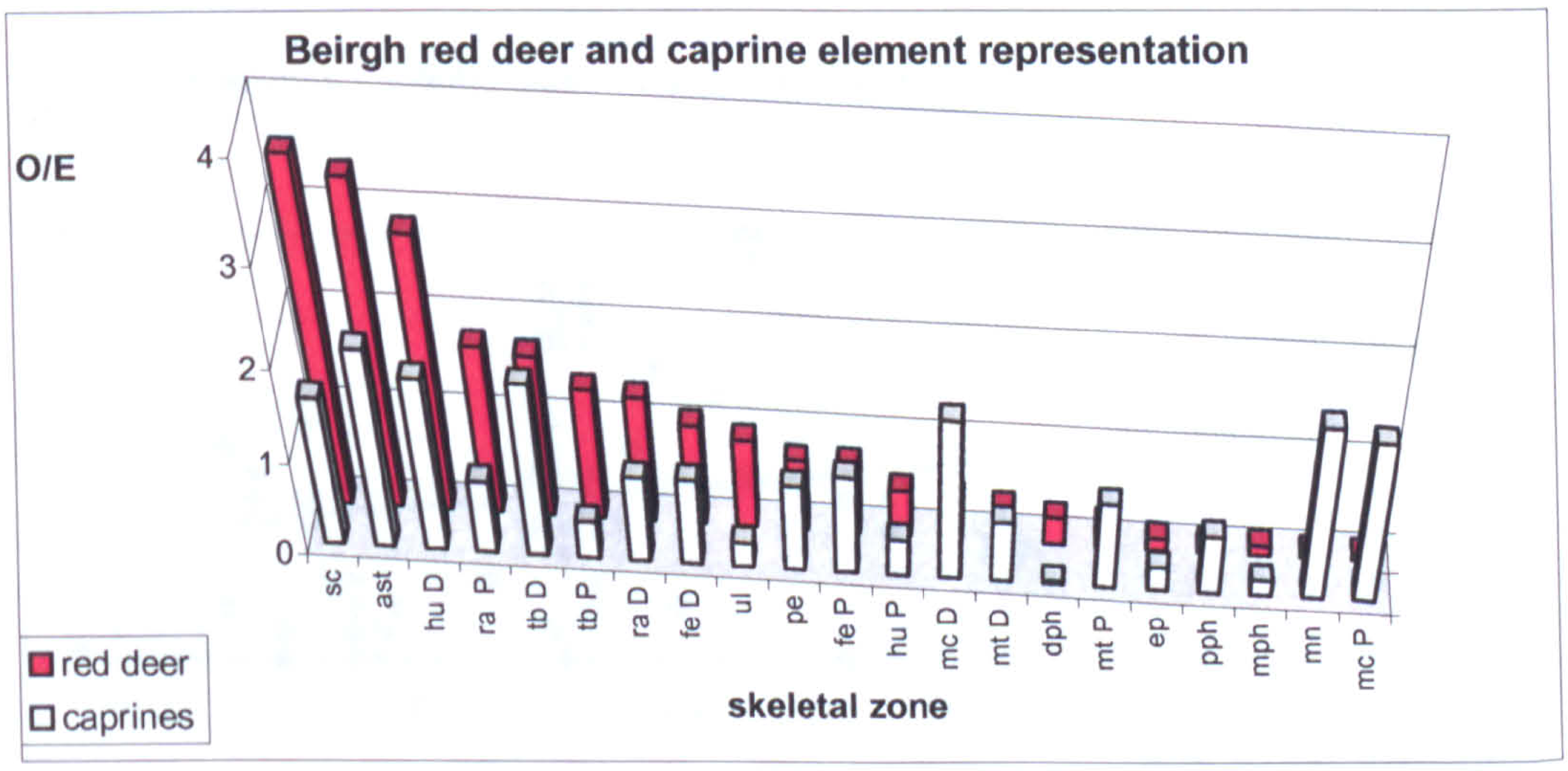
fore-limb	hind-limb	head
sc	pe	mn
hu P	fe P	ep
hu D	fe D	at
ra P	tb P	
ra D	tb D	
ul	cal	**feet**
mc P	ast	pph
mc D	mt P	mph
	mt D	dph

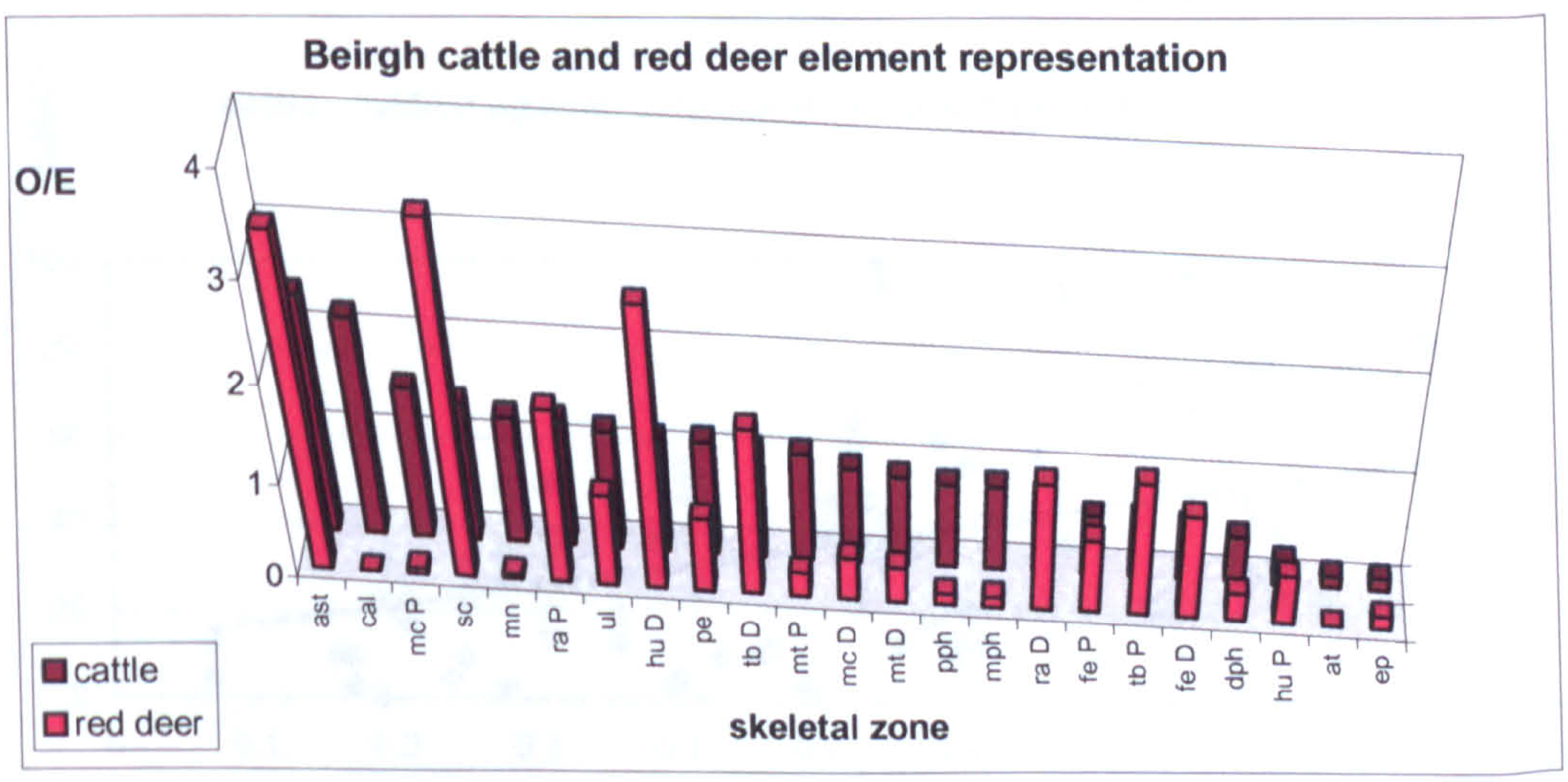
Key to abbreviations

ast	astragalus	**ra**	radius
at	atlas	**tb**	tibia
cal	calcaneum	**sc**	scapula
dph	distal phalanx	**ul**	ulna
ep	epistropheus (axis)	**D**	distal
fe	femur	**P**	proximal
hu	humerus		
mc	metacarpal		
mn	mandible		
mph	middle phalanx		
mt	metatarsal		
pe	pelvis		
pph	proximal phalanx		

Figure 5.7: Comparisons between element distributions of taxa

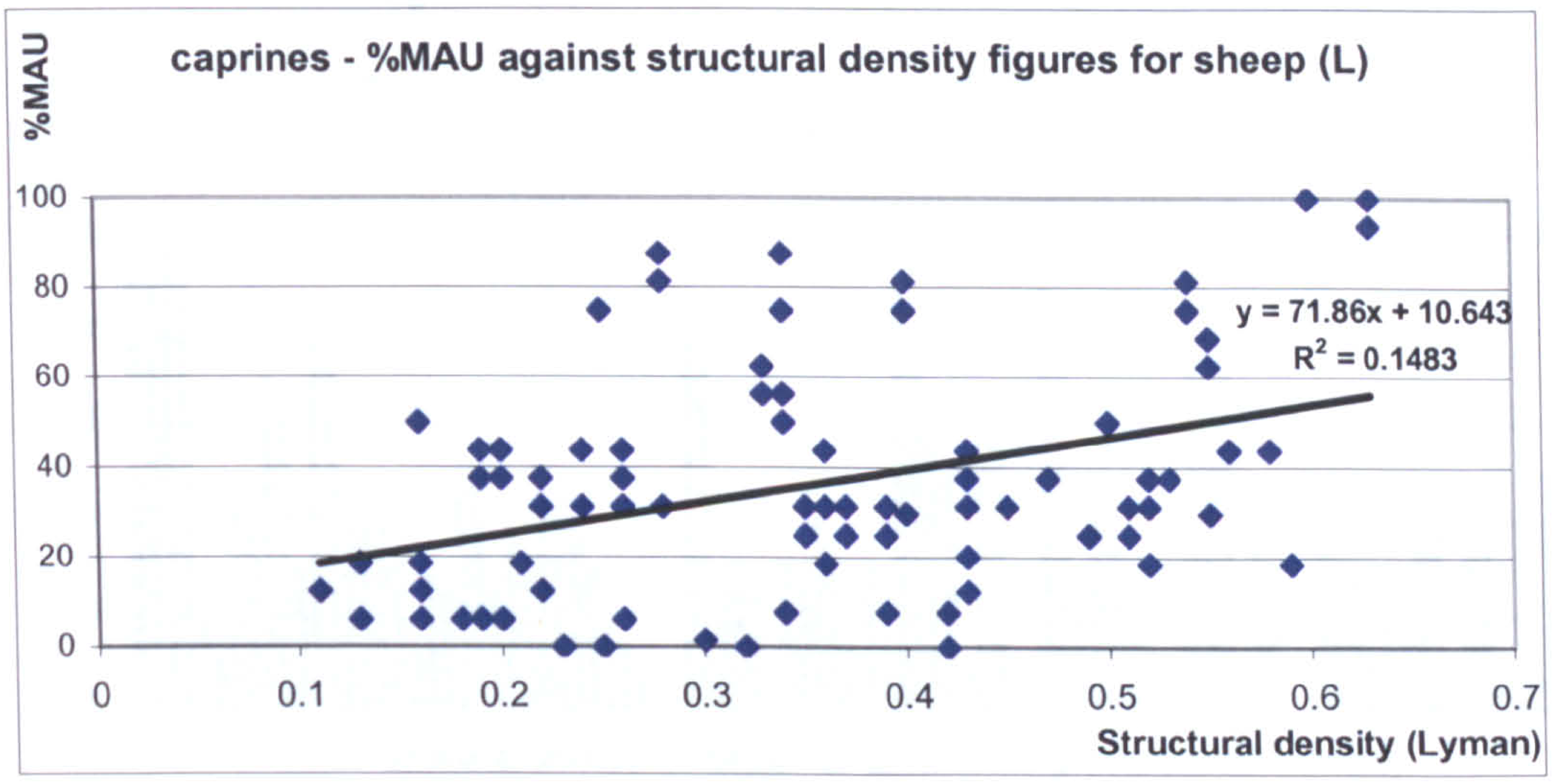


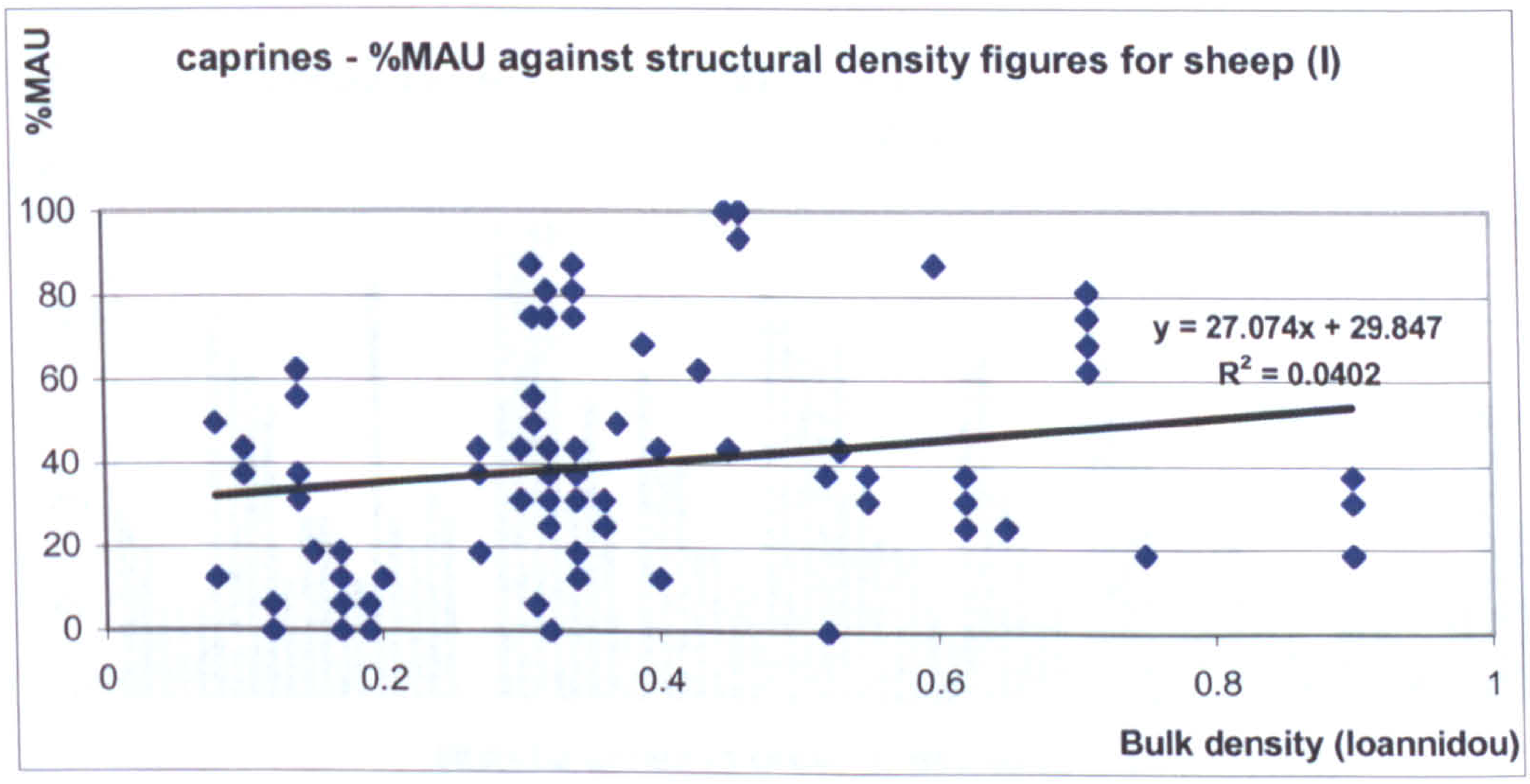




Key to abbreviations as in Figure 5.6

Figure 5.8: structural densities and bone survival from Beirgh





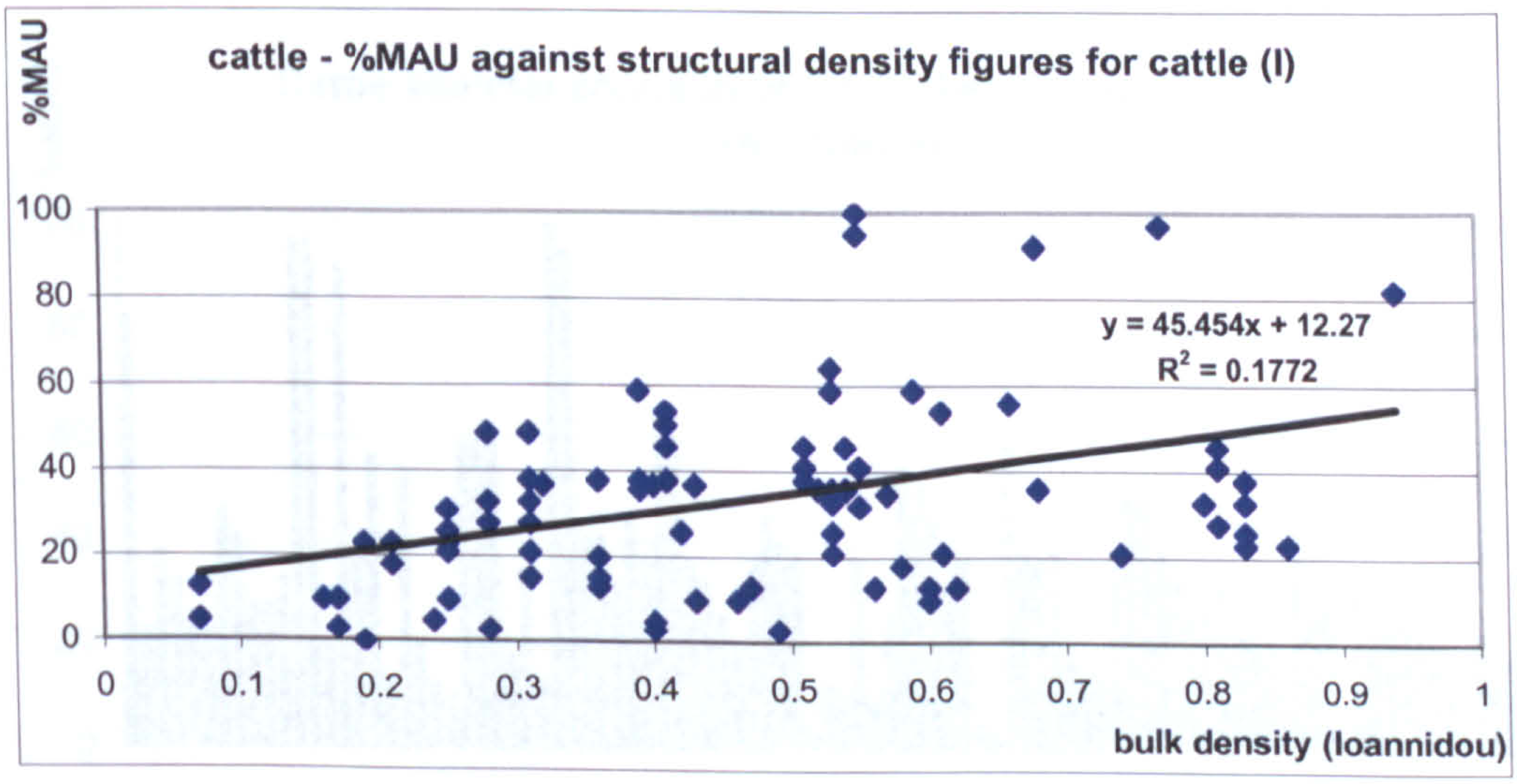
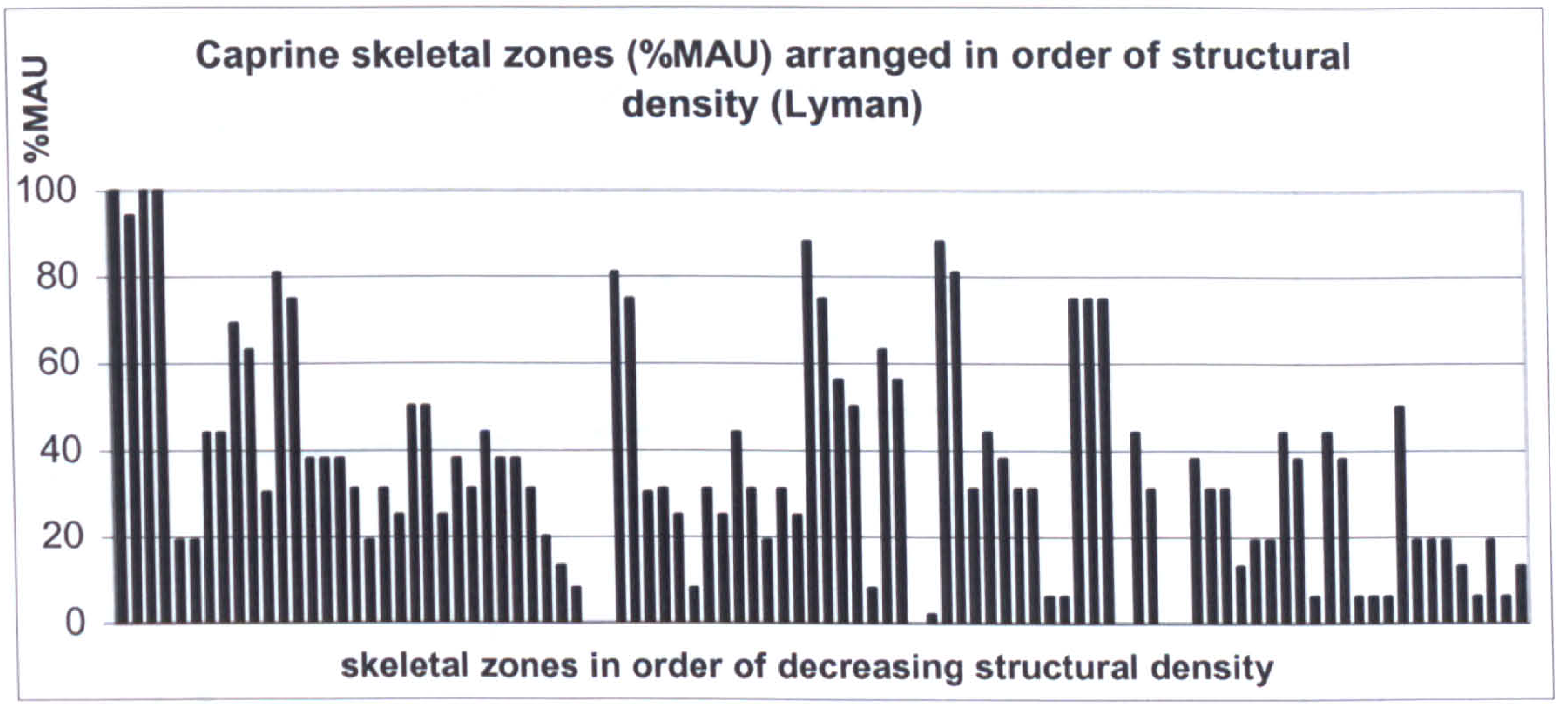
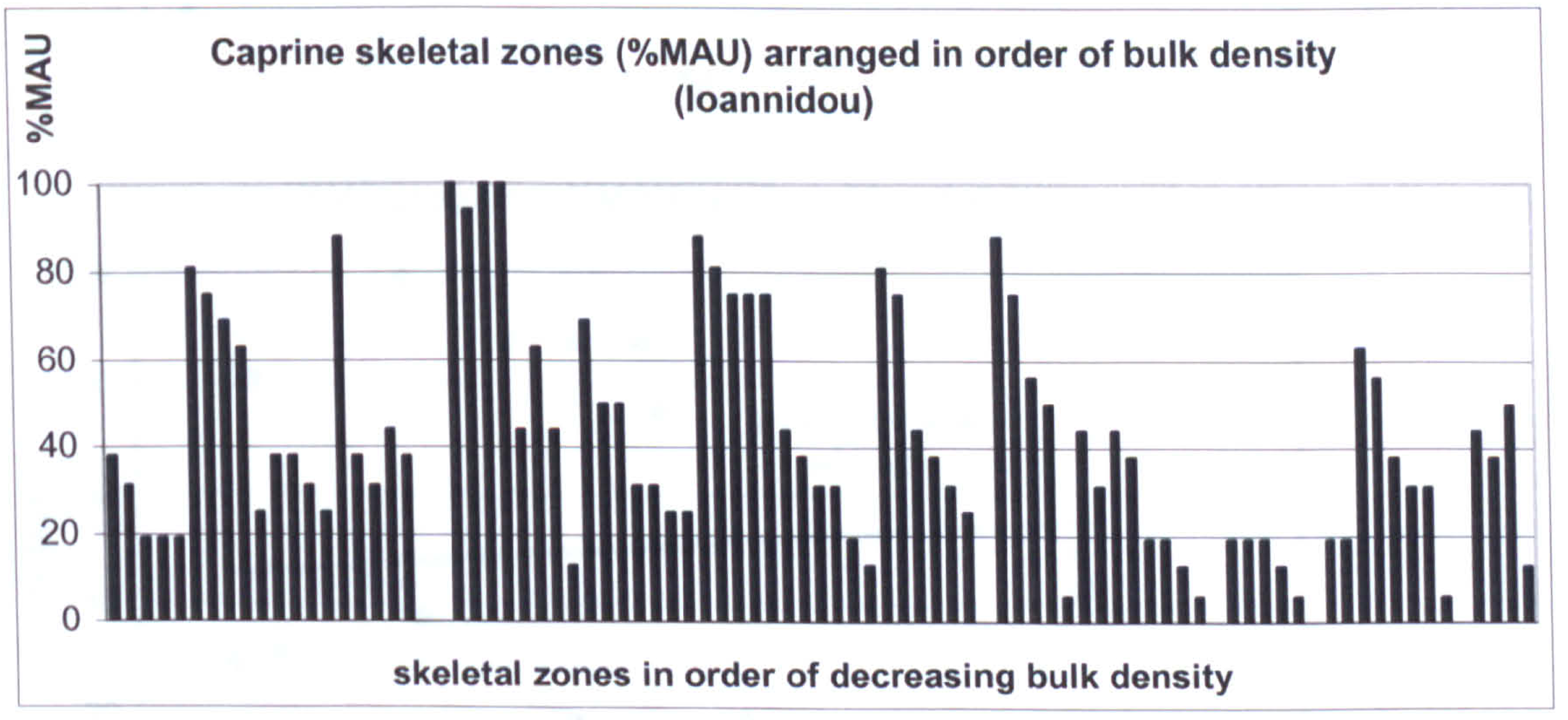


Figure 5.9: %MAU of skeletal zones arranged in order of decreasing structural density





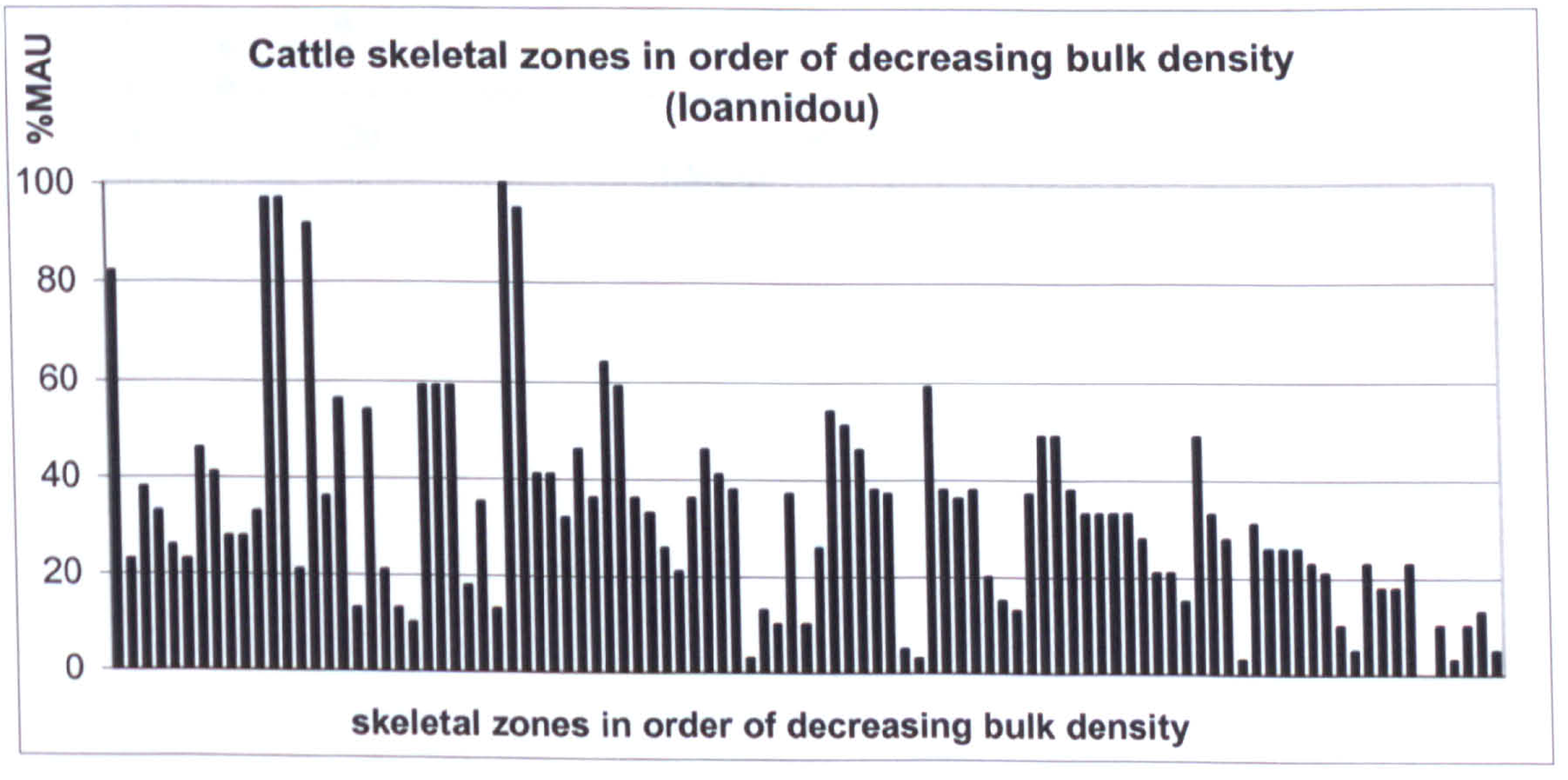
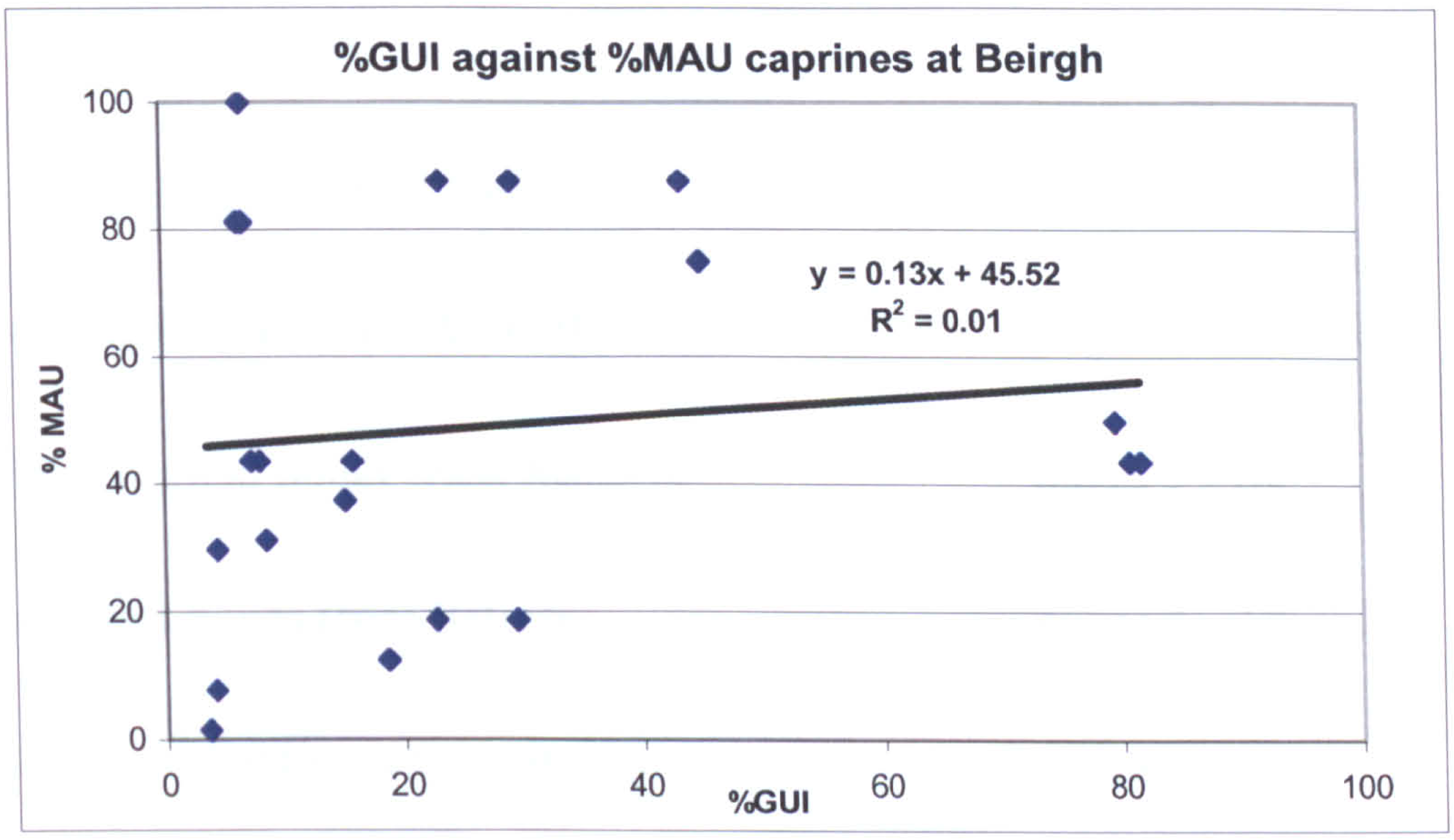
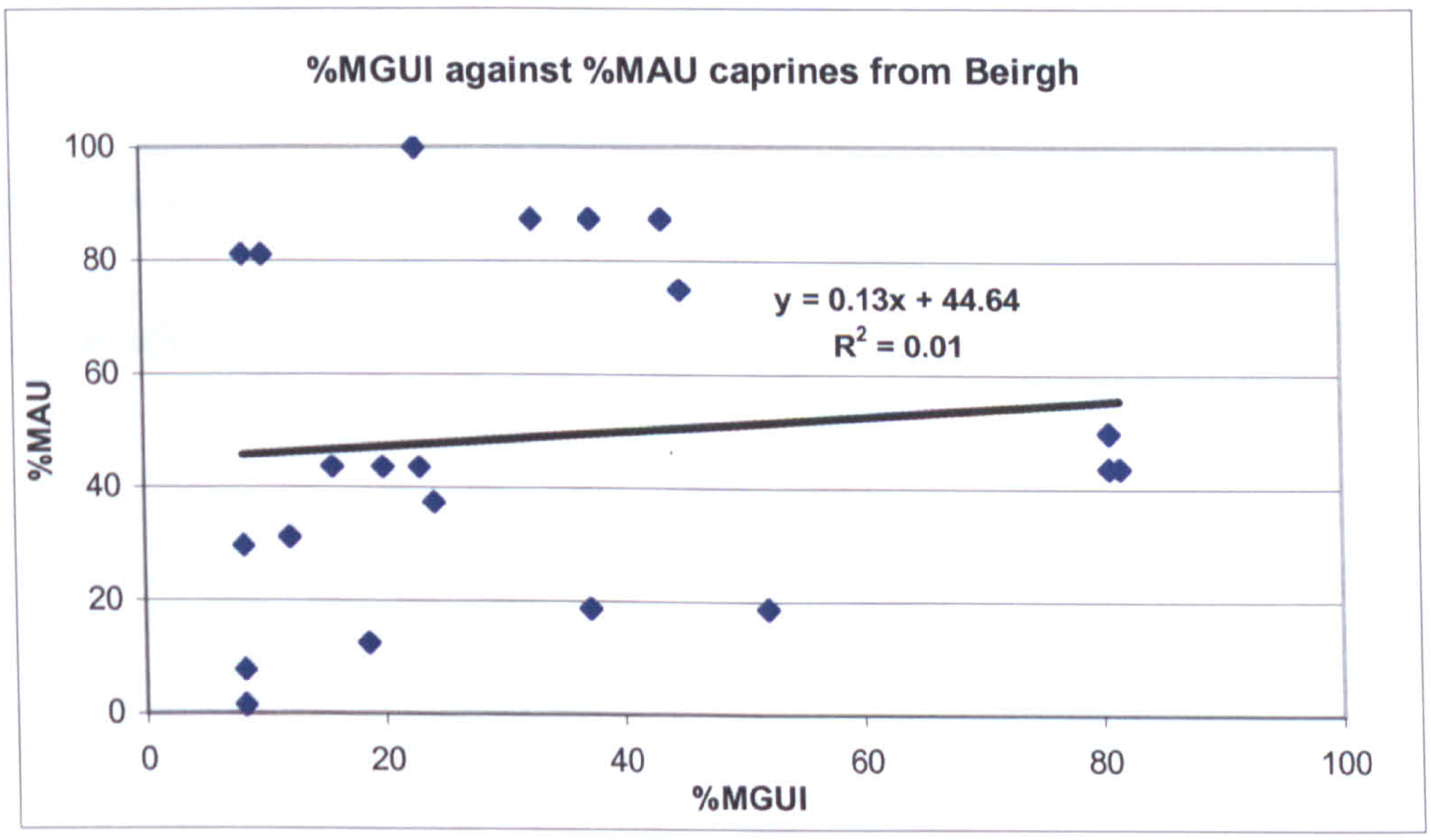


Figure 5.10: Utility indices for caprines at Beirgh





Appendices

Key to Appendices 1 and 2

PRESERVATION CODES (Pres)

Code	Meaning
a	Excellent; fresh app
b	Good,: solid, v. local flakiness if any
c	Fair: flaky / powdery < 50% of surface
d	Poor: flaky / powdery > 50% of surface

STAINING (St)

Code	Staining
0	No staining
1	< 25% stained
2	25 – 50 % stained
3	50 – 75% stained
4	> 75% stained

GNAWING (Gn)

code	Gnawing mark
gn	carnivore gnawing
rd	rodent gnawing

EPIPHYSEAL FUSION

Code	Fusion state
f	fused
u	unfused
fu	fusing
n	not present

BURNING

Code	Burning
char	**black / grey**
cal	**white**

BUTCHERY (Bu)

Code	butchery mark
fm	filleting mark
dm	dismembering mark
kn	fine knife mark
cm	chop marks
sfm	filleting mark made with serrated blade
sm	skinning mark
chv	chopped vertically
chh	chopped horizontally

TAXA CODES

CODE	TAXON
bt	*Bos taurus*
car	carnivore
cf	*Canis familiaris*
ch	*Capra hircus*
cc	*Capreolus capreolus*
ch	*Capra hircus*
ec	*Equus cabullus*
lgm	large mammal (horse, cow red deer)
lgr	large ruminant (red deer, cattle)
ll	*Lutra lutra*
mdm	medium mammal (sheep, goat, roe, large dog)
oa	*Ovis aries*
ovc	caprine
slm	small mammal (dog, fox, cat)
slr	small ruminant (sheep, goat, roe)
ss	*Sus scrofa*

ELEMENT CODES

mn	mandible
M	molar
M1	first molar
M1 / M2	first or second molar
mlr	molar tooth (not identifiable further)
P	permanent premolar
dp	deciduous premolar
In	Incisor
Cn	canine
at	atlas
ep	epistropheus
sc	scapula
hu	humerus
ra	radius
ul	ulna
mc	metacarpal
pe	pelvis
fe	femur
tb	tibia
fb	fibula
ast	astragalus
cal	calcaneus
mt	metatarsal
pph	proximal phalanx
mph	middle phalanx
dph	distal phalanx

ELEMENT ZONES

Element zones follow Dobney and Rielly (1988). Additional codes are shown below

Code	Zone(s) represented
$	3 or 4
&	5 or 6
£	7 or 8
#	10
@	11

Cranial bones from Bostadh

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	dp2	L		1 2		b	0					1.5						37
bt	dp2	R		1 2		b	0					1.4						365
bt	dp3	R		1 2		b	0				illeg	2.3						0
bt	dp3	l		1 2		b	0					1.9						112
bt	dp4	l		1 2		b	0					4.5	e					315
bt	dp4	r		1 2		b	0					5.1	l					112
bt	dp4	r		1 2		b	0					3.7	a					53
bt	dp4	r		1 2		b	0					3.1	b					288
bt	dp4	R		1 2		b	0					7.1	h					78
bt	dp4	R		1 2		b	0					4.9	d					443
bt	dp4	R		1 2		b	0					2.1	c					378
bt	dp4	l		1 2		b	0					3						112
bt	dp4	R	Grant - "b	1		b	0					3.4						615
bt	dp4	r		1 2		a	0					4.8	a					53
bt	dp4	R	Grant - "a	1		b	0					3.7						539
bt	dp4	L	Grant - "a	1		b	0					3.8						539

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	dp4	L	Grant - "b	1		b 0					4.6						622
bt	dp4	l		1 2		b 0					5.1	l					112
bt	M1 /	L		1 2		b 0					8.7						61
bt	M1 /	L		1 2		b 0					6.6						822
bt	M1 /	L		1 2		b 0					14.4						120
bt	M1 /	L		1 2		b 0					12.8						40
bt	M1 /	r			1 2	a 0					3						717
bt	M1 /	L		1 2		b 0					12.7						276
bt	M1 /	L		1 2		b 0					13.5						653
bt	M1 /	l		1 2		b 0					12.8						53
bt	M1 /	r		1 2		b 0					17.4						53
bt	M1 /	L		1 2		b 0					10.4						71
bt	M1 /	l		1 2		b 0					16						112
bt	M1 /	l		1 2		b 0					17.6						112
bt	M1 /	l		1 2		b 0					13.5						112
bt	M3	L	young adu	1 2		b 0					31.5					e	120
bt	M3	l		1 2		b 0					11.2					a	53
bt	M3	R	Adult	1 2		b 0				099?	23.9					g	98

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	M3	R	Old adult	1 2		b 0					17.9					h	175
bt	M3 fr	L	adult	2 1		b 0					14.4					g	226
bt	M3 fr	L	old adult	2	1	b 0					18.4					j	378
bt	M3 fr	L	adult	1 2		b 0					14.3					g	435
bt	mlr	R		1 2		b 0					11.1						397
bt	mlr	R	Grant - "g	1	2	b 0					16.7						612
bt	mlr	R	Grant - "d	1	2	b 0					12.6						288
bt	mlr	R		1 2		b 0					13.6				g		466
bt	mlr	R		1 2		b 0											227
bt	mlr	R		1 2		b 0					7.7						17
bt	mlr	L	Grant - "d	1	2	b 0					16.8						626
bt	mlr	-	Grant - "a	1	2	b 0					7.2						53
bt	mlr	-	Grant - "a	1	2	b 0					10.4						508
bt	mlr	L	Grant - "c	1	2	b 0					16.7						175
bt	mn	l			6	b 0					6.3						53
bt	mn	L		3 5	4 6	b 0	gn?	2dm	5		25						329
bt	mn	r			1	c 0					7.8						53
bt	mn	r			5	c 0					5.1						53

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	mn	r		5	3	b	0					10.2						53
bt	mn	r		5		b	0		5 cm	5		18.1						53
bt	mn	L		4 5	3	b	0					13.5						402
bt	mn	L		3 5		b	0					6.8						251
bt	mn	l		6		b	0					31.5						112
bt	mn	r			6	b	0					16.5						53
bt	mn	L		5		c	0					9.2						138
bt	mn	L		4		b	0					7.9						378
bt	mn	L		1	2	b	0					12.4						226
bt	mn	L	Young		5	d	0				abraded	4						38
bt	mn	L		1	2	b	0					8.1						120
bt	mn	l		4		b	0					7.9						112
bt	mn	L		5		b	0				(or 364) water abr	9.9						344
bt	mn	r			3 4 5	b	0					5.4						112
bt	mn	l		4	3	b	0					4.1						53
bt	mn	l		7	2	b	0					3.7						53
bt	mn	l			6	b	0					15.2						53
bt	mn	r		1 2 6 7	3	b	0					158			h	f	E	112

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	mn	r		6	1 3 5	b	0		3 fm	6		39.7						112
bt	mn	r		1		b	0					27.6		c	d			107
bt	mn	r		2	1 7	b	0		cm	1	pathology - unusu	35.7						50
bt	mn	r			1	b	0		1 km	1		16.2						188
bt	mn	r		5	3	b	1		cm	5		13.9						419
bt	mn	r		7	2	b	0					11.7						112
bt	mn	l			5 6	b	0					11.5						112
bt	mn	r		3 5	6	b	0					23.1						112
bt	mn	r		4	3	b	0					9.9						112
bt	mn	r		4		b	0					5.2						112
bt	mn	l			6	b	0					14.4					g	60
bt	mn	l		1 2	3 6	b	0				mn, P4 - M3	198		a	g	g	b	112
bt	mn	L		3 4 5 6		b	0					52						56
bt	mn	l			6	b	0					6.1						112
bt	mn	L		4 5	3 6	b	0		4 fm	5		33.5						276
bt	mn	l			6	b	0					5.7						112
bt	mn	l		5	3 6	c	0					16						112
bt	mn	l		3 5	4	b	0					20.7						112

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	mn	l		2	6	b	0					32						60
bt	mn	r		5	3	c	0					13.9						112
bt	mn	L		5	3 6	b	0					50						61
bt	mn	L	0 - 1 mo	1 3 4 5 6		b	0				Mn - dp3 - dp4	23	a		v			653
bt	mn	R	B (1 - 8 m		1	b	0				Mn - dp4 - M1	24.3	f		a			365
bt	mn	R		1 2 7	6	b	0				Mn - P3 - M3	116						205
bt	mn	L		3 5	6	c	0				Water worn	20.3						390
bt	mn	R		2 7		b	0					8.4						218
bt	mn	R		3 4	5	c	0					7.2						38
bt	mn	R		3 4	5 6	b	0					17.5						173
bt	mn	L		3 4 5	6	c	0					38.6						276
bt	mn	R		6	3 5	c	0					16.6						508
bt	mn	R		3 4 5	6	b	0					36.5						122
bt	mn	L	1 - 8 mo	1 2 6		b	0				Mn -dp2 - M1	18.9	d					329
bt	mn	R		4	3 5	b	0					12.2						508
bt	mn	L	8 - 18 mo	1 2 6		b	0				Broken and mende	58.7	g		b			402
bt	mn	R		3 5		c	0					18.3						123
bt	mn	l			1	b	0					3.8						79

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	mn	R			1 2	b	0				Mn - dp2	1.9						365
bt	mn	R	A (0 - 8 m	1 2 6 7	3 5	b	0				Mn - dp2 - dp4	20	a		v			662
bt	mn	R	B (1 - 8 m	1 2	7	b	0		4+ dm	2	Mn - dp2 - dp4	15.5	c					638
bt	mn	R	C (8 - 18	1 2 7		b	0				Mn - dp2 - M1	60.6	h		f			53
bt	mn	R	B (1 - 8 m	1 2	7	c	0				Mn - dp2 - dp4	12.9	d					54
bt	mn	R		2 7	1	b	0					31.4	h					288
bt	mn	R			1 2	b	0		4 fm	3	Mn - dp2 (+ poss	7.8						365
bt	mn	R		2 7	1	d	0				Mn dp2 - dp3	19.4						66
bt	mn	L		3 5	4 6	b	0					23.7						650
bt	mn	L		2	7	c	0					18.2						61
bt	mn	L	8 - 18 mo	3 4 5 6	1	b	0					51.2						673
bt	mn	L		2	1	b	0				Mn - P2 - P3	16.1						173
bt	mn	L	-	7	2	b	0					10.3						112
bt	mn	L		4	3 5	b	0					10.4						61
bt	mn	L	0 - 1 mo	1 2		b	0				Mne - dp2 - dp4	17.2	a					628
bt	mn	L	0 - 1 mo	1 6 3 4	5	d	0				Circular hole in 1,	23.7	a		v			435
bt	mn	L		1	6	b	0				Pathology? No sig	44.4			m	j		149
bt	mn	L	> 8 - 19 m	1		b	0				Mn - dp4 - M1	31.9	j		d			53

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt	mn p	L		l	2	b 0					1.1						626
bt	P2	l		1 2		b 0					0.8						112
bt	P2	r		1 2		b 0					0.8						112
bt	P2	l		1 2		b 0					1.1						379
bt	P2	l		1 2		b 0					1.2						59
bt	P2	r		1 2		b 0					0.5						60
bt	P3	L		1 2		b 0					1.1						54
bt	P3	L		1 2		b 0					2						625
bt	P3	r		1 2		b 0					2						50
bt	P3	r		1 2		b 0					1.5						658
bt	P3	r		1 2		b 0					1.9						112
bt	P3	l		1 2		b 0					4.9						112
bt	P4	R		1 2		b 0					7.6		f				603
bt	P4	R		1 2		b 0					5.1		f				445
bt	P4	L		1 2		b 0					5		g				653
bt	P4	L		1 2		b 0					5.1		g				379
bt	P4	l		1 2		b 0					4.6		h				53
bt	P4	r		1 2		b 0					4.5		f				867

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
bt?	mn	R			3 5 6	b	0		knife ma	3		27.7						276
bt?	mn	R			1 6	b	0					43 2						276
bt?	mn	L	-		1	b	0					15.9						61
ce	dp3	l		2 7	1	b	0					8.7						315
ce	dp3	r		1 2		b	0					1.8						107
ce	dp4	R	< 1 yr	1 2		b	0					2.1						86
ce	dp4	L		1 2		b	0					1.9						61
ce	dp4	l		1 2		b	0					2	g					60
ce	dp4	R	< 1 yr	1 2		b	0					2.6						35
ce	M1 /	r		1 2		b	0					4.9						50
ce	M1 /	l		1 2		b	0					5.1						120
ce	M1 /	r		1 2		b	0					4.1						53
ce	M3	R	5 - 6 yrs	1 2		b	0					7.9						56
ce	M3	L		1 2		b	0					8.5						61
ce	M3	R	7 - 9 yrs	1 2		b	0					6.7						56
ce	M3	r		1 2		b	0					8.2					c	53
ce	M3	L		1 2		b	0					7						34
ce	mlr	L		1 2		b	0					4.6						620

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ce	mlr	L		1 2		b	0					5.7						56
ce	mlr	L		1 2		b	0					6						56
ce	mlr	L		1 2		b	0					4.6						56
ce	mlr	R		1 2		b	0					3.4						120
ce	mlr	L		1 2		b	0					4.6						35
ce	mlr	L		1 2		b	0					3.7						207
ce	mn	L		2 7	1	b	0					10.6						56
ce	mn	R		3 4 5		b	0					5.3						56
ce	mn	L		2 7		b	0					12						39
ce	mn	L		2 7	1	b	0					12.3						61
ce	mn	L		3 4 5	6	b	0					13.2						35
ce	mn	r		6		b	0					14						53
ce	mn	r			1	c	0					3.2						53
ce	mn	L		3 4 5	6	b	0					14.5						620
ce	mn	r		2	@	c	0		cm	2		8.6						53
ce	mn	L	> 9 yrs		1 6	b	0				(M2 - M3)	19.9						383
ce	mn	R	>8 - 10 yr		1 6	b	0				(M3)	24.5						101
ce	Mn	R	4 yrs	1	6	b	0				(M 1 - M2)	34.2						56

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ce	mn	R	5 yrs		1	b 0				Mn (P2 - M1)	21						98
ce	mn	R	> 9yrs		1 6	b 0				(M3)	12.1						120
ce	mn	R	5 yrs	2 7	1	b 0		6 fm	2	Mn (P3 - P4)	18.6						379
ce	mn	l		5	3	b 0					2.7						53
ce	mn	R	7 - 9 yrs		1 6	b 0				Mn (M3)	15.3						285
ce	mn	R			3 5	b 0					3						402
ce	mn	R	5 - 6 yrs	2 7	1	b 0		1 dm, 1 f	2	Mn (P2 - P3)	13.4						66
ce	Mn	R	Neonatal	1 2 3 4 5		b 0				(dp2 - M1)	11.1						209
ce	mn	R		3 4 5	6	b 0					15						61
ce	mn	L	> 6 yrs	1		b 0				Mn (P3 - M1)	14.6						34
ce	mn	R		4	3 5	b 0					5.7						34
ce	mn	L	2 - 3 yrs	1 2 7		b 0				(M1)	19.9						35
ce	mn	L			1	b 0					9.5						37
ce	mn	r			1	b 0		5 km	1		10.1						61
ce	mn	L			1	b 0					8.1						35
ce	mn	l		3 5	4 6	b 0					18.4						64
ce	mn	R		3 4 5	6	b 0					14.2						122
ce	mn	L	>12 yrs	1	2	b 0				Mn (P2 - M1)	16.3						365

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ce	mn	L	4 - 5 yrs	1		b	0				Mn (P2 - M2)	37.5						98
ce	P2	L		2	1	b	0					1.8						34
ce	P2	l		1 2		a	0					0.4						53
ce	P3	l		1 2		a	0					1.9						53
ce	P3	L		1 2		b	0					2.4						34
ce	P4	R	> 9 yrs	1 2		b	0					2.1						414
ce	P4	R	> 9 yrs	1 2														378
ce	P4	L		1 2		b	0					1.9						285
ce	P4	L		1 2		b	0					1.5						355
ce	P4	r		1 2		b	0					2.4		f				53
ce?	mn	L			1 6	c	0					2.1						35
cf	M1	l		1 2		b	0					0.4						148
ch	mn	R	2 - 6 mont	1 2 3 4 5		b	0		3 disme			12.8	14		3B			363
ch	mn	L	C (6 - 12	1 2 3 4 5		b	0		30+ fm	1		16.8	14		6A	v		226
ch	mn	L	> B (2 - 6	2	1	b	0				Mn - dp2 - dp4	4.1	14					142
ch	mn	L		1 2		b	0				Mnlr dp4	0.8	13					680
ec	Cn	R		1 2		b	0					2						315
ec	ln	l		2	1	b	0					6.6						148

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ec	In 1	R	old	1 2		b 0					6.4						315
ec	In 1	L	old	1 2		b 0					6.3						315
ec	In 2	L	old	1 2		b 0					7.5						315
ec	M2?	R		1 2		b 0					24.5						812
ec	M3	R		2	1	b 0				new brk	17.5						315
ec	mlr	R		2	1	b 0				new break	14.4						315
ec	mn	r			6	b 0		2 kn	6		31.7						315
ec	mn	R			1	b 0		2 km		tooth sockets	10.6						315
ec	mn	l			6	b 0					21.7						315
ec	mn	L		1 2	6	b 0		4 fm	1	Mn- P2 - M2	178						423
ec	mn	L		1	6	b 0				new breaks (P2 -	161						138
ec	mn	L			6	b 0					45.2						138
ec	mn	L	old	1	2	b 0		4 fm	1	Mn P2 - P3	113						315
ec	mn	B	old		7	b 0					6.1						315
ec	mn	R		3 4 5	6	b 0		3 cm	5	poss burning on 3	135						284
ec	mn	R		5	3	b 0					21.5						853
ec	mn	R		5		b 0					13.5						56
ec	mn	R		2	1	b 0				roots	20.9						514

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ec	mn	R			6	b	0					11.3						87
ec	mn	L		1 2		b	0				Mn ? M2	38.9						315
ec	Mx m	L		1 2		b	0											284
ec	tooth	l	worn to ro	1 2		b	0					35.5						261
ec	tooth	l	worn to ro	1 2		b	4				burnt	16.6						315
hg	mn	r		3 4 5 6	1	b	0				young	4.7						363
lgm	ln	-				b	0					0.7						653
lgm	ln	-				b	0					0.3						98
lgm	ln	-				b	0					0.4						620
lgm	ln	-				b	0					1						120
lgm	ln	-				b	0					0.3						604
lgm	ln	-				b	0					0.7						539
lgm	ln	-				b	0					1.9						364
lgm	ln	-				b	0					0.8						378
lgm	ln	-				b	0					1.2						285
lgm	ln	-				b	0					1.1						816
lgm	ln	-				b	0					0.4						653
lgm	ln	-				b	0					0.6						37

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
lgm	ln	-				b	0					0.6						822
lgm	ln	-				b	0					0.4						138
lgm	ln	-				b	0					0.6						26
lgm	ln	-				b	0					0.6						120
lgm	ln	-				b	0					0.7						620
lgm	mn	L			1	b	0					31.7						221
lgm	Tooth	-				b	0					1.1						378
lgm	tooth	-				b	0					5.9						388
lgr	dp4	r		1 2		b	0					2.7	n					112
lgr	ln	L		1 2		b	0					1.9						514
lgr	ln	L		1 2		b	0					2.1						462
lgr	ln	L		1 2		b	0					2						512
lgr	ln	-		1 2		b	0					2.1						512
lgr	ln	L		1 2		b	0					1.6						514
lgr	ln	-		1 2		b	0					1.2						603
lgr	M1 /	l		1 2		b	0					0.6						379
lgr	mlr	-			1	b	0		?? Cm			1.6						378
lgr	mlr	L		1 2		b	0				very worn	4.7						173

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
lgr	mn	-			1	b	0					1						112
lgr	mn	-			1	b	0					3.5						112
lgr	mn	-			1	b	0					1.9						315
lgr	mn	r		7	2	b	0					1.6						611
lgr	mn	-			1	b	0					0.7						288
lgr	mn	r		3 5		b	0					4.7						112
lgr	mn p	-		2	1	c	4					1.7						435
lgr	mn p	-			1	b	0					0.4						48
lgr	mn p	-		2	1	b	0					1.2						1
ll	mn	l	juv	1 2 3 4 5		b	0				P4 emerging	4						129
ll	mn	r		1 2 3 4 5		b	0		4 km	1		6.6						129
ll	mn	l		1 2 3 4 5		b	0					5.1						422
ll	mn	r		1 2 3 4 5		b	0					7.5						363
ll	mn	r		1 2 3 4 5		b	0					8.4						53
ll	mn	l		1 2 3 4 5		b	0					4.8						603
ll	mn	l		1 3 4 5 6		b	0					6.3						482
ll	mn	r		1 2 3 4 5		b	0					4.9						365
ll	mn	l		1 2 3 4 5		b	0					7.5						662

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ll	mn	l		1 2 3 4 5		b	0					5.3						122
ll	mn	l		1 2 3 4 5		b	0					6.4						285
ll	mn	r		1 2 7		b	0					2.9						363
mdm	In	-				b	0					0.1						120
mdm	In	-				b	0					0.1						653
mdm	In	-				b	0					0.3						539
mdm	In	-				b	0					0.3						365
mdm	In	-				b	0					0.4						120
mdm	In	-				b	0					0						364
mdm	In	-				b	0					0.3						378
mdm	In	-				b	0					0.1						83
mdm	In	-				b	0					0.4						209
mdm	In	-				b	0					0.3						539
mdm	In	-				b	0					0.3						388
mdm	mlr	-		1														365
oa	dp3	l		1 2		b	0					0.1						165
oa	dp4	R		1 2		b	0					0.8	14					54
oa	dp4	l		1 2		b	0					0.7	br					53

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
oa	dp4	l		1	2	b	0					0.9						112
oa	dp4	l		1 2		b	0					1.2	16					112
oa	dp4	r		1	2	b	0					1.2	16					112
oa	dp4	l		1 2		b	0					0.8	15					53
oa	dp4	r		1 2		b	0					0.8	16					454
oa	dp4	l		1 2		b	0					1.1	13					74
oa	mn	R		1 2		b	0					1.1	14					378
oa	mn	R		1 2		b	0					1.3	14					199
oa	mn	L	D (1 - 2 yr	1 2 6 7	3	b	0				Burnt (dp2 - M2)	23.3	22		9A	6A	not v	148
oa	mn	L		1 2 7		b	0				Mn - dp2 - dp3	4.8						234
oa	mn	L	6 - 12 mo	1 2 6 7		b	0				Mn - dp2 - M2	11.5	16		6A	e		653
oa	mn	L	6 - 12 mo	1 2	6	b	0				Mn - dp2 - M2	6.9	16		5A	v		250
oa	mn	R		1 2							Mn dp4		14					512
oa	mn	l			1	b	0				Mn, P2 - dp3	0.7						288
oa	mn	R	E (2 - 3 yr	1 2 7		b	0					29.5		7A	9A	7A	2A	56
oa	mn	R	> 21 - 24	1 2		b	0				New break	17.4		4A	9A	5A	-	149
oa	mn	R	> 21 - 24	1 2 7		b	0					10.6		12S	12A	9A	-	288
oa	mn	R	> 21 - 24		1 2	b	0				New break	4.5		2C	-	-	-	425

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
oa	mn	R	D (1 - 2 yr	1 2	6 7	b	0					17.8				5B	0	37
oa	mn	R	>D (1-2 yr	1 2		b	0					9.2			8A	5B		276
oa	mn	l			1	b	0					1.6	16					112
oa	mn	L	B (2 - 6 m	1 2 6 7		b	0				Mn - dp2 - M1	12.2	16		5A	v		364
oa	mn	r		1 2 7		b	0		4 fm	2		7.9	14		3C			285
oa	mn	R	-		1 2	d	0				very worn	2.4						378
oa	mn	r		1	2	b	0					4.2	16					112
oa	mn	R	6 - 9 mo	1 2 3 5 6		b	0					10.7	14		4C	v		88
oa	mn	R	6 - 9 mo	1 2 3 5 6		b	0					17.4	16		5A	v		205
oa	mn	R	B (2-6 mo	1 2		b	0					6.5	16		3C			164
oa	mn	R	> C (6 - 1	1 2	7	b	0					9.4	14		8B			142
oa	mn	R	> C (6 - 1	1 2 7		b	0		6 fm			10.1	20		9A			138
oa	mn	R	C (6 - 12	1 2 7	6	b	0					7.9	16		6A	v		439
oa	mn	R	> C (6 - 1	1 2	7	b	0					7.8	14		7A			414
oa	mn	R	E (2 - 3 yr	1 2 6 7		a	0					32.8		7A	9A	8A	2A	188
oa	mn	R	-		1 2	b	0					2.1						378
oa	mn	r		1 2	7	b	0					9.8	16		4C			112
ovc	dp2	r		1 2		b	0					0.1						285

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	dp2	l		1 2		a	0					0.4						305
ovc	dp2	l		1 2		b	0					0.05						112
ovc	dp2	l		1 2		b	0					0.2						288
ovc	dp3	l		1 2		b	0					0.2						112
ovc	dp3	r		1 2		b	0					0.3						454
ovc	dp3	L		1 2		a	0					0.3						26
ovc	dp3	l		1 2		b	0					0.2						112
ovc	dp4	r		1 2		b	0					0.6	23					315
ovc	dp4	l			1	b	0					0.3	br					53
ovc	M1	R		1 2		b	0					2.2			9A			822
ovc	M1	R		1 2		b	0					1.8			9A			36
ovc	M1	R		1 2		b	0					1.8			9A			365
ovc	M1	L	> C (6 - 1	1 2		b	0					1.1			12A			355
ovc	M1	R		1 2		b	0					1.8			9A			86
ovc	M1 /	R		1 2		c	0					0.5						519
ovc	M1 /	R		1 2		b	0					2.7						98
ovc	M1 /	l		1 2		b	0					3.6						53
ovc	M1 /	r		1 2		b	0					2.3						53

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	M1 /	r		1 2		b	0					4.3						53
ovc	M1 /	r		1	2	b	0					2						53
ovc	M1 /	r		1 2		b	0					2.2						112
ovc	M1 /	l		1 2		b	0					2						454
ovc	M1 /	l		1 2		b	0					3.3						288
ovc	M1 /	l		1 2		c	0					2.1						86
ovc	M1 /	l		1 2		b	0					2.2						379
ovc	M1 /	l		1 2		b	0					1.3						112
ovc	M1 /	l		1 2		b	0					1.1						112
ovc	M1 /	l		1 2		b	0					1.7						454
ovc	M1 /	r		1 2		b	0					1.6						19
ovc	M1 /	r		1 2		b	0					1.4						112
ovc	M1 /	r		1 2		b	0					3.4						112
ovc	M1 /	r			1	b	0					0.7						454
ovc	M2	L	> D (1 - 2	1 2		b	0					3.7				8A		173
ovc	M2	L		1 2		b	0					1.9				9A		37
ovc	M2	L	> D (1 - 2	1 2		b	0				half of occlusal sfc	2.4						435
ovc	M2	L	> E(2 - 3	1 2		b	0					4.3				8A		98

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	M2	R		1 2		b 0					3.1				6A		86
ovc	M2	R		1 2		b 0					3.2				8A		626
ovc	M3	L	? 6 - 12 m	1 2		b 0				probably unerupte	0.9					0	378
ovc	M3	l		1 2		b 0					3.2					11G	288
ovc	M3	r		1 2		b 0					4.2					11G	149
ovc	M3	r		1 2		b 0					6.7					4A	53
ovc	M3	L	D (1 - 2 yr	1 2		b 0					5.4					2A	61
ovc	M3	L	D (1 - 2 yr	1 2		b 0				poss 040.3	5.4					2A	40
ovc	M3	l		1 2		b 0					4					brk	53
ovc	M3	L	> G (4 - 6	1 2		a 0					4.5					11G	514
ovc	M3	L	F (3 - 4 yr	1	2	b 0		chopped			3.1					10G	355
ovc	M3	r		1 2		b 0					4.6					1A	288
ovc	M3	l		1 2		b 0					5.1					9G	884
ovc	M3	R	> G (4 - 6	1 2		b 0					3.7					11G	653
ovc	M3	R	> G (4 - 6	1 2												11G	228
ovc	M3	R	> G (4 - 6	1 2		b 0					4					11G	9
ovc	M3	L	> E(2 - 3	1 2		b 0					5.8					2A	98
ovc	M3	r		1 2		b 0					4.3					11G	419

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	M3	r		1		a 0					1.9					10G	173
ovc	M3	l		1 2		b 0					4.7					2A	53
ovc	mlr	L		1 2		a 0					2.9						510
ovc	mlr	L		1 2		b 0					4						328
ovc	mlr	R		1 2		b 0					3.5						620
ovc	mlr	R		1		b 0				spec no may be 31	1.4						218
ovc	mlr	L	(not in we	1 2		b 0				not erupted	0.6						471
ovc	mlr	L		1 2		b 0					3.7						98
ovc	mlr	R		1 2		b 0					1.4						56
ovc	mlr	R		1 2		a 0					2						142
ovc	mn	R	-	3 4 5	6	c 0					2.2						508
ovc	mn	L		1 2 7		b 0				Mn - dp2 + frag d	4.4						288
ovc	mn	L	> D (1 - 2	1		c 0				Mn - dp4 - M2	9.5	23		9A	6A		385
ovc	mn	L	D (1 - 2 yr	1 2	6 7	b 0					15.2	18		9A	5A	v	378
ovc	mn	l		4		b 0					1						64
ovc	mn	l		5	3	b 0					1.4						379
ovc	mn	l		2	1	b 0					5.1	16					454
ovc	mn	r		5	3 6	c 0					5.2						53

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	mn	-			1	b	0					1.6						250
ovc	mn	L	> C (6 - 1	2		b	0				Mn - dp4 - M1	5.2	16		6A			364
ovc	mn	L	> C (6 - 1	1 2 7		b	0				Mn - dp2 - M1	8.3	16		8A			328
ovc	mn	l		5		b	0					0.6						112
ovc	mn	l		4		b	0					0.6						112
ovc	mn	L		2		b	0					6.2						120
ovc	mn	l		2 7	1	b	0				Mn, P2, P3	7.2						53
ovc	mn	l		3 4 5		b	0					1.9						285
ovc	mn	L	D (1 -2 yr	1 2 7		b	0				Mn - P2 - M3	20.2		8A	9A	8A		384
ovc	mn	L		4 5	3	b	0					2.5						120
ovc	mn	l		5	6	b	0					2.4						50
ovc	mn	L		3 4 5		b	0					2.8						378
ovc	mn	r		4 5	3	c	0		2 kn	3-5		6.4						173
ovc	mn	L		3 4 5 6		b	0					10					v	188
ovc	mn	L		3 4	5	b	0					3.6						378
ovc	mn	L		3 5		b	0					3.5						378
ovc	mn	L		3 4 5		b	0					3.8						250
ovc	mn	r		5	3 6	b	0					6.8						64

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	mn	L		3 4 5	6	c	0					3.1						34
ovc	mn	l		1 2 7		b	0				Mn, P2 - M2	12		9A	14A	9A		884
ovc	mn	L	G (4 - 6 yr	1 2 7	6	b	0				pathology	31.4		15A	12A	9A		53
ovc	mn	L		1 2 7		c	0				Mn- dp3 - M2	12.4		4A	9A	7A		635
ovc	mn	L			3 4 5	b	0					2.9						41
ovc	mn	L		3 4 5 6	1	b	0				Mn - M3	21.1					16G	221
ovc	mn	L		1 2		c	0				Mn - P2 - M1	15.2		9A	9A			173
ovc	mn	L		1 3 4 5 6		b	0				218b (P4 - M1)	27.4		8A	9A	8A		218
ovc	mn	l		4	3	b	0					0.5						112
ovc	mn	l		2 7	1	b	0					1.7						112
ovc	mn	l		4 5	3	b	0					0.8						112
ovc	mn	r		4		b	0					0.3						112
ovc	mn	L				b	0				Mn - P2 - M1	9		5A	9A			149
ovc	mn	L		1 2 7		b	0				Mn - P3 - M1	9.1		12S	9A			355
ovc	mn	L	F (3 - 4 yr	3 4 5 6	2	b	0				Mn - M2 - M3	28.3				9A	2A	188
ovc	mn	r		3 4 5		b	0					2						632
ovc	mn	R		1 2		c	0				poss 086	0.7	23					88
ovc	mn	r		2 7		b	0					1.1						112

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	mn	l		5	3 4 6	b 0		3 km	5		2.1						19
ovc	mn	L		1 2		a 0				Mn dp3	0.2						426
ovc	mn	R	-	3 5	6	c 0					5						56
ovc	mn	L		1 2		a 0				Mn dp3	0.2						60
ovc	mn	r		5		b 0					0.4						112
ovc	mn	L		2 7	1	b 0					3.4						603
ovc	mn	r		5		b 0					0.6						112
ovc	mn	r		5	3 6	b 0					1.2						112
ovc	mn	r		5	3	c 0					0.8						288
ovc	mn	r		4		b 0					1.2						50
ovc	mn	R		1 2		b 0				Mn dp4	1.1	16					98
ovc	mn	r		4	3	b 0					1.4						50
ovc	mn	L	> B (2 - 6	1 2		b 0					0.6	16					36
ovc	mn	l		4		b 0					1.7						53
ovc	mn	l		5	3 4	c 0					1.9						53
ovc	mn	l		4	3	b 0					4						53
ovc	mn	l		2 7	1	b 0					4.6						53
ovc	mn	R		1 2 7		b 0					14.1		2C	9A	8A		40

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	mn	L		5		b	0					2						397
ovc	mn	L		5		b	0					2.7						218
ovc	mn	L		5		c	0				abraded	2.4						53
ovc	mn	L			5	b	0					0.6						364
ovc	mn	R		5		d	0					1.4						37
ovc	mn	R		5		b	0					1.6						164
ovc	mn	L		2	1 7	c	0				Mn P2, P3	1.2						426
ovc	mn	r		4	3	b	0					1.2						315
ovc	mn	r		2	1 7	b	0				Mn, P3	3						112
ovc	mn	R	-	3 4	5	b	0					2.1						101
ovc	mn	R	-	3 4 5		b	0					3						276
ovc	mn	r			1 2	b	0					1.3						379
ovc	mn	r		2	1	b	0					6.7		4A	9A			717
ovc	mn	r		2	7	b	0					1.6						454
ovc	mn	l		5	3	b	0					1.3						112
ovc	mn	l		5	3	b	0					0.8						112
ovc	P2	l		1 2		b	0					0.05						454
ovc	P3	R		1 2		b	0					0.3						471

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	P3	r		1 2		b 0					0.4						112
ovc	P3	R		1 2		b 0					0.4						37
ovc	P3	l		1 2		b 0					0.5						53
ovc	P3	R		1 2		b 0					0.3						510
ovc	P3	L		1 2		b 0				unmkd	0.2						0
ovc	P3	R		1 2		b 0					0.1						120
ovc	P3	R		1 2		b 0					0.2						26
ovc	P4	r		1 2		b 0					0.3		15A				41
ovc	P4	r		1 2		b 0					0.3		15A				112
ovc	P4	r		1 2		b 0					0.2		15A				112
ovc	P4	r		1 2		b 0					0.2		15A				112
ovc	P4	r		1 2		b 0					0.2		15A				112
ovc	P4	r		1 2		b 0					0.2		15A				112
ovc	P4	L		1 2		b 0					0.9		9A				101
ovc	P4	r		1 2		b 0					0.2		15A				112
ovc	P4	r		1 2		b 0					0.5		15A				250
ovc	P4	l		1 2		a 0					0.3		9A				112
ovc	P4	l		1 2		b 0					0.2		15A				285

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ovc	P4	l		1 2		b	0					0.2		15A				872
ovc	P4	l		1 2		b	0					0.2		15A				64
ovc	P4	r		1 2		b	0					0.2		15A				59
ovc	P4	R		1 2		b	0					0.8		2C				37
ovc	P4	l		1 2		a	0					0.3		15A				112
ovc	P4	l		1 2		b	0					0.1		15A				148
ovc	P4	l		1 2		a	0					0.2		15A				884
pine	mn	l		1 2 3 4 5		b	0					3.2						129
slr	dp2	r		1 2		a	0					0.1						112
slr	dp3	r		1 2		a	0					0.2						112
slr	M1 /	r		1	2	a	0					0.3						354
slr	mn	R	-		5	b	0				young	1						471
slr	mn	R	-		5	b	0					1.5						378
ss	dp4	l		1 2		b	0				fragmented	0.1	br					53
ss	ln	l				c	0				male	6.6						53
ss	mn	R		1	2	b	0				in 2 bits	26.9		c	j	e		98
ss	mn	L		1 6		b	1		roots		Mn dp3 - M2	59.1	g		d	a		99
ss	mn	l			7	c	0					4.7						148

Sp	Elem	Side	Age	Frag> 50%	Frag< 50%	Pres	St	Gn	Butcher	Bu zo	Other	Weight	dp4	P4	M1	M2	M3	Con
ss	mn	r			1	b	0					10.9						53
ss	Mx m	-	well worn	1 2		b	0					4.1						148
ss	Mx m	R		1 2		b	0					5						129
ss	Mx m	R ?	well worn	1	2	b	0					1.8						129

Post-cranial bones from Bostadh

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	ast	L			1 2 3 4		b	0		7 dm, 2 dm	3, 4		42	118
bt	ast	R			1 2 3 4		c	0					13.2	363
bt	ast	l	-	-	1 2 4		b	4					22.3	64
bt	ast	R			1 2 3 4		b	0					32.8	612
bt	ast	R			1 2 3 4		b	0					24.9	818
bt	ast	R			1 2 3 4		b	0		4 km	2		33.2	199
bt	ast	R			1 2 3 4		c	0					26.4	190
bt	ast	R			1 2 3 4		c	0					27	539
bt	ast	R			1 2 3 4		b	0					21.8	200
bt	ast	R			1 2 3 4		b	0		2 dm	3 4		31.6	129
bt	ast	R			1 2 3 4		b	0					42.6	138
bt	ast	R			1 2 3 4		b	0					32.4	379
bt	ast	L			1 2 3 4		b	0					25.4	378
bt	ast	R			1 2 3 4		b	0		1 dm, 6 dm, 3dm, 4 dm	1, 2, 3, 4		27.5	363
bt	ast	L			1 2 3 4		b	0					29.3	209
bt	ast	R			1 2 3 4		c	0					20.9	8
bt	ast	L			1 2 3 4		b	0					38.3	397
bt	ast	L			1 2 3 4		b	0		3 dm, 15 dm,	4, 2		26.4	97
bt	ast	L			1 2 3 4		b	0					20.8	397
bt	ast	L			1 2 3 4		b	0		4 dm, 1 ?dm	3, 4, 4		22.6	662

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	ast	L			1 2 3 4		b	0					24.1	138
bt	ast	L			1 2 3 4		b	0					32.5	435
bt	ast	L			1 2 3 4		b	0					34.9	149
bt	ast	r	-	-	1 2 3 4		c	0					23.7	112
bt	ast	r	-	-	1 2 3 4		b	0		2 cm, 2 cm 3 fm	3, 4		40.2	362
bt	ast	r	-	-	1 2 3 4		c	1		8 dm, 3 dm	3, 4	burnt	22.2	112
bt	ast	l	-	-	1 2 3 4		b	0					27.3	112
bt	ast	l	-	-	1 2 3 4		c	0	gn				28.7	53
bt	ast	L			1 2 3 4		b	0					22.4	281
bt	ast	L			1 2 3 4		b	0				neonat	6	626
bt	ast	R			1 2 3 4		b	0					30.2	221
bt	ast	L			1 2 3 4		b	0				neonat	5	615
bt	ast	R			1 2 3 4		b	0				neonat	7.1	433
bt	ast	L			1 2 3 4		c	0				neonat	5.9	529
bt	ast	L			1 2 3 4		b	0				neonat	6.9	653
bt	at	-		f		1	b	0					3.1	512
bt	at	-		f		1	b	0		2 cm	1		17	56
bt	at	-		f		1	c	0		2 cm	1		7.9	329
bt	at	-		n	1	2	b	0					14.6	388
bt	at	-		n	2		c	0					35.3	56
bt	at	-				2	b	0					19	112
bt	at	-			1	2	b	0		3 dm	1		33.9	112
bt	at	-		n	2		b	0					12	388

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	cal	L	n		2 3 4	5	b	0					28.7	383
bt	cal	L	f		1 2 3 4 5		b	0					39.1	188
bt	cal	l	u	-	1		b	0		1 cm	1		4.5	112
bt	cal	l	u	-	2 3 4 5		b	0		1 cm	2		36.1	112
bt	cal	l	f	-	1 2 3 4 5		b	0		7 km	3		44.4	441
bt	cal	r	u	-	2 4		b	0					4	53
bt	cal	L	n		2 3 4 5		b	0					29	276
bt	cal	l	u	-	2	3 5	c	0	gn				5.1	173
bt	cal	L	n		2 3 4 5		b	0					33.3	138
bt	cal	L	n		5		b	0					2.8	615
bt	cal	L	f		1 2 3 4 5		b	0					38.1	355
bt	cal	L	n		2 5	3	c	0					23.4	188
bt	cal	L	n		2 3 4 5		b	0	0	4 ? dm	2		28	54
bt	cal	L	u		2 3 4 5		b	0					24.7	281
bt	cal	R	f		1 2 3 4 5		b	0					39.8	221
bt	cal	R	u		1		b	0					4.1	363
bt	cal	R	u		2 3 4 5		b	0					28.7	363
bt	cal	R	n		2 3 4 5		b	0					23.1	61
bt	cal	R	n		4	2 3	b	0					11.8	425
bt	cal	R	n		3 4 5		b	0					11.5	355
bt	cal	L	f		1 2 3 4 5		b	0					43.1	378
bt	cal	L	n		5		b	0					2	363
bt	dph	r			1 2		b	-	-	-	-	-	9.6	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	dph	l			1 2		b	-	-	-	-	-	9.6	112
bt	dph	r			1 2		b	-	-	-	-	-	5.9	112
bt	dph	r			1 2		c	-	-	chop	1	-	2.6	112
bt	dph	r			1 2		b	-	-	-	-	-	5.6	112
bt	dph	r			1 2		b	-	-	-	-	-	6.1	112
bt	dph	r			1 2		b	-	-	-	-	-	8.8	431
bt	dph	r			1 2		b	-	-	-	-	-	8.3	112
bt	dph	r			1 2		b	-	-	-	-	-	8.3	53
bt	dph	r			1 2		b	-	-	-	-	-	8.9	112
bt	dph	L	f		1 2		b	0					9.8	658
bt	dph	r			1 2		b	-	-	-	-	-	6.8	112
bt	dph	l			1 2		b	-	-	-	-	-	7.1	112
bt	dph	r			1 2		b	-	pun	chop	2	-	5.6	112
bt	dph	r	-	-		1 2	b	4	-	-	-	char	2.2	863
bt	dph	R	f		1 2		b	0					5.6	378
bt	dph	R	f		1 2		c	0					4.8	281
bt	dph	R	f		1 2		b	0					11.1	39
bt	dph	r	-		1	2	b	3	-	-	-	cal	3.1	112
bt	dph	R	f		1 2		c	0					7.7	97
bt	dph	L	f		1 2		b	0					7.8	173
bt	dph	L	f		1 2		b	0					7.7	37
bt	dph	R	f		1 2		b	0					7.1	120
bt	dph	r			1 2		b	-	-	-	-	-	9.1	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	dph	l			1 2		b	-	-	-	-	-	8.8	112
bt	dph	R	f		1 2		b	0					6.2	39
bt	dph	L	f		1 2		b	0					6.5	120
bt	dph	L	f		1 2		b	0					4.8	284
bt	dph	L	f		1 2		b	0					8.7	120
bt	dph	L	f		1 2		b	0					5.8	443
bt	dph	l	-	-	2	1	b	4	-	-	-	char	4	863
bt	dph	L	f		1 2		b	0					6.2	603
bt	dph	r	f	-	1	2	c	4				burnt	3.2	112
bt	dph	l				12	b	-	-	-	-	-	3	707
bt	dph	r			1 2		b	-	-	-	-	-	2.8	112
bt	dph	l			1 2		b	-	-	1 km	2	-	6.6	112
bt	dph	L	f		1 2		b	0					7.6	61
bt	dph	l			1 2		b	-	-	-	-	-	7.2	112
bt	dph	l			1 2		b	-	-	-	-	-	6.5	112
bt	dph	l			1 2		b	-	-	-	-	-	11.2	53
bt	dph	l	-	-	1	2	b	4	-	-	-	char	3.5	863
bt	dph	l	-	-	2		b	4		2 dm	2	cal	2.3	863
bt	dph	L	f		1 2		b	0					8.3	120
bt	dph	R	f		1 2		b	0					5.1	112
bt	dph	L	f		1 2		b	0					8.8	120
bt	dph	l	-		1	2	b	2	-	-	-	char	2.9	863
bt	dph	L	f		1 2		b	0					7.3	281

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	dph	l			1 2		b	-	-	-	-	-	5.9	112
bt	ep	-		n		1	b	0					3	603
bt	ep	-		n		1	b	0		1 cm	1		18.2	112
bt	ep	-		n		1	b	0					130	529
bt	ep	-		n		1	b	0					8.1	431
bt	ep	-		u	1 2 3 4		b	0					31.4	388
bt	fe	r	n	u	9 #		d	0					9.5	315
bt	fe	R	f	n	4	5	b	0					26.2	653
bt	fe	R	n	n	1		b	0					16.3	98
bt	fe	R	f	n	2 3 4 5	6	b	0					99.1	378
bt	fe	R	f	n	1 2 3 4 5		b	0					88.6	603
bt	fe	R	n	n	5	2 3	b	0		ch	5		40.1	54
bt	fe	L	fu	n	4	5	b	0					22.2	657
bt	fe	l	n	n		8	b	0					15.5112	603
bt	fe	L	n	f	9 @	# 7	d	0					14	9
bt	fe	r	n	u		8	b	0					4.8	315
bt	fe	r	f	n	2	3 6	b	0		5 km	6		19.8	717
bt	fe	R	n	n	7 8		b	0					44.7	97
bt	fe	l	u	n	1		c	0					11.6	112
bt	fe	l	u	n	3		b	0					4.4	53
bt	fe	l	u	n	2 3 5		b	0					33	112
bt	fe	l	u	n	2 3 5	6	b	0					45.3	112
bt	fe	l	u	n	1		b	0					9	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	fe	l	n	u	9 #	@	c	0					36.1	112
bt	fe	L	n	u	9 # @		c	0					15.8	615
bt	fe	L	n	u		8	b	0					40.9	120
bt	fe	l	u	n	1		c	0					9.8	112
bt	fe	L	f	n	4	5	b	0					31.9	37
bt	fe	L	n	n	8	7	b	0					19.6	61
bt	fe	L	f	n	4	5	b	0					29.8	56
bt	fe	L	f	n	4	5	b	0					19.5	529
bt	fe	l	n	u	9		b	0		1 dm	9		22.6	112
bt	fe	l	n	u	@		c	0					13.5	112
bt	fe	L	u	n	4		b	0					9.7	98
bt	fe	l	n	n		3 6 7	b	0		30 fm	6		43.3	112
bt	fe	L	n	u	#	@	b	0					45	120
bt	fe	l	n	u	6 7 8		b	0		4 fm	7		79.1	112
bt	fe	L	n	f	7 8 #	9 @	c	0					105.4	149
bt	fe	R	u	n	4		b	0					9.7	112
bt	fe	L	f	n	4	5	b	0					15.7	149
bt	fe	l	n	u	7 8		b	0					46.3	112
bt	fe	L	n	n	7	-	b	0					19.8	397
bt	fe	L	n	n	2		b	0					13.6	53
bt	fe	L	fu	n	4 5	2 3	b	0					23.1	365
bt	fe	L	n	n	2 5	3	b	0				Poss con 029?	32.5	620
bt	fe	L	f	n	1	3 5	b	0					45.4	188

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	fe	L	fu	n	1 2 3 4 5	6	b	0		3 fm	6		106.9	378
bt	fe	R	n	f	9 #	@	c	0					29.8	97
bt	fe	R	n	f	9 # @	7 8	b	0					94.7	615
bt	fe	R	n	u		7 8	b	0					31.9	40
bt	fe	L	n	n	2		b	0					13.8	529
bt	fe	L	u	n	4		b	0					10.4	19
bt	hu	L	n	f	3 4 5 6 7 8		d	0					75.2	461
bt	hu	L	n	f	3 4 5 6	7 8	c	0				nb	76.6	138
bt	hu	L	n	f	3 4 5 6	7 8	c	0					48.7	199
bt	hu	L	n	f	3 4 5 6	7 8	c	0		7 fm, 6 fm	8,		91.3	380
bt	hu	L	u	n	@	9 #	b	0		10 fm	#	(114?)	33.7	11
bt	hu	L	n	n		7 8	b	0					21.8	234
bt	hu	L	n	n	9	7	b	0					25.4	615
bt	hu	R	f	f	1 2 3 4 5 6 7 8 9 # @		b	0					180.2	74
bt	hu	R	n	f	3 4 5 6	7 8	b	0					90.1	173
bt	hu	R	n	n		5	b	0					5.7	436
bt	hu	R	n	n		7 8	b	0					22.9	40
bt	hu	R	n	n		7 8 9 10	b	0					24	363
bt	hu	R	n	f	3 4 5 6	7 8	c	0					72.5	218
bt	hu	l	n	n		1	c	0					8.1	50
bt	hu	R	n	n		7 8	b	0					11.8	205
bt	hu	L	n	f		5	c	0					19.7	612
bt	hu	r	f	f	9 #	7 8	b	0					60.7	221

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	hu	R	n	f	3 4 5 6	7 8	b	0					64.9	88
bt	hu	L	f	n	2 @	1	b	0					59.8	615
bt	mc	R	f	n	2	6	b	0					13.1	149
bt	mc	r	f	n		1 2 5	b	0					9.1	441
bt	mc	l	f	n		2 6	c	0					3.9	121
bt	mc	l	f	n	1	5	b	4					5	112
bt	mc	-	n	u	$		b	0		2 dm	$		2.9	112
bt	mc	R	f	u	2 6 8	1 7	b	0					50.1	530
bt	mc	l	f	n	1 2 5	6	b	0					16.1	261
bt	mc	R	f	n	1	5	b	0					4.9	281
bt	mc	l	f	u	1 2 5 6 7 8		b	0		1 fm	8		51.8	112
bt	mc	R	f	n		2 5 6	b	0					7.9	355
bt	mc	R	n	f	3 4	7 8	b	0					20.3	365
bt	mc	R	f	n	1	2 5 6	b	0					16.4	56
bt	mc	R	f	f	6 8	2	b	0					38.1	61
bt	mc	R	f	n		2 6 8	b	0					22.9	288
bt	mc	R	n	f	3 4	7 8	c	0					20	61
bt	mc	R	n	u	3 4		b	0					16.7	530
bt	mc	r	f	f	1 2 3 4 5 6 7 8		b	0					77.5	112
bt	mc	R	u	u	5 6 7 8		b	0					16.3	173
bt	mc	r	u	n	5 6		c	0		5 dm, 2 dm	1, 2	neonatal	4.3	379
bt	mc	R	u	u	5 6 7 8		b	0					11.9	88
bt	mc	L	f	n	1	5	d	0					13.1	435

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mc	-	n	n	&	£	c	0					2.5	646
bt	mc	R	f	n	1 2	5 6	b	0					8.6	149
bt	mc	l	f	f	1 2 3 4 5 6 7 8		b	0					76.3	112
bt	mc	r	f	f	1 2 3 4 5 6 7 8		c	0					84.9	112
bt	mc	R	f	n	1 2 5	6	b	0					28.9	496
bt	mc	r	f	f	1 2 3 4 5 6 7 8		b	0					74.4	112
bt	mc	r	f	f	1 2 3 4 5 6 7 8		b	0					78.5	112
bt	mc	r	f	n	1 2 5	6	b	0					29.4	53
bt	mc	r	f	n	1 2 5 6	7 8	b	0					51.3	112
bt	mc	l	f	u	1 2 5 6 7 8		b	0					32.1	112
bt	mc	l	f	u	1 2 5 6 7 8		b	0					31.9	112
bt	mc	l	f	u	1 2 5 6 7 8		b	0					47.2	112
bt	mc	r	f	f	1 2 3 4 5 6 7 8		b	0					74.5	112
bt	mc	-	n	u		7 8	b	0					6.4	129
bt	mc	-	n	f	$	£	b	0		1 fm	£		17.5	149
bt	mc	L	f	n		2 6	b	0		5 fm	6		4.9	173
bt	mc	R	f	n		1 5	b	0					4.5	662
bt	mc	L	f	n	1 2 5 6 7 8		b	0					42.7	620
bt	mc	L	f	f	1 2 3 4 5 6 7 8		b	0					75	653
bt	mc	L	f	f	1 2 5 6	7 8	c	0					44.2	123
bt	mc	L	f	n	1 2	5 6	b	0		6 fm	6		26.8	816
bt	mc	L	f	n	2	6 8	b	0		5 ?fm	6		17.9	620
bt	mc	R	n	f	3 4 7 8	5	b	0					38.5	365

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mc	-	n	f		£ $	b	0					11.3	653
bt	mc	-	f	n		2 6	b	0					2.2	205
bt	mc	L	f	u	1 2 5 6 7 8		c	0					22.1	53
bt	mc	R	f	n	1	2 5 6	b	0					10.9	466
bt	mc	R	n	f	3 4 7 8	5 6	b	0					52.3	61
bt	mc	R	f	f	1 2 3 4 5 6 7 8		b	0					72.1	97
bt	mc	L	n	f	3 4	7 8	b	0		10 dm	7 8		28.6	149
bt	mc	L	u	u	3 4 5 6	.	b	0					13.4	363
bt	mc	L	f	n	1 2	5 6	b	0					20.3	388
bt	mc	L	n	f	3 4	7 8	b	0					24.3	120
bt	mc	L	f	n		2 6	b	0					11	615
bt	mc	L	f	n	1	2 5	b	0					6.2	653
bt	mc	L	f	n		1 5	b	0					8.4	436
bt	mc	-	n	n		5 6 7 8	b	0		2 ?km	5 / 6		6.6	379
bt	mc	R	f	f	1 3 4 5 6 7 8		c	0		nb			66	20
bt	mp	-	n	u	$		b	0					1.1	148
bt	mp	-	n	u		7 8	b	0					1.4	607
bt	mp	-	n	u	$		b	0					1.1	148
bt	mp	-	n	u	$		b	0					1.2	645
bt	mp	-	n	u	$		b	0					2.4	364
bt	mp	-	n	f	$	£	b	0					3.5	35
bt	mp	-	n	u	$		b	0					1.7	88
bt	mph	L	f		1 2 3		b	0					5.2	38

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mph	L	f		1 2 3		b	0		5 km	1		7.8	98
bt	mph	L	f		1 2 3		b	0		3 km	3		6.8	443
bt	mph	l	f		1 2 3		b	-	-	2 fm	3	-	6.7	112
bt	mph	L	f		1 2 3		c	0					5.8	528
bt	mph	l	f		1 2 3		c	-	-	-	-	-	6.9	112
bt	mph	L	f		1 2 3		b	0					11.6	173
bt	mph	L	f		1 2 3		b	0					9.5	98
bt	mph	r	u		2 3		c	-	-	-	-	-	1.2	58
bt	mph	L	f		1 2 3		b	0		8 km, 2 km	3, 1		7.6	120
bt	mph	L	f		1 2 3		b	0		1 + ? km	1		7.6	626
bt	mph	l	u	f	2 3		b	0					1.1	868
bt	mph	L	f		1 2 3		b	0					5.3	112
bt	mph	L	f		1 2 3		b	0					6.3	522
bt	mph	l	f		1 2 3		b	-	-	-	-	-	7.7	112
bt	mph	L	f		1 2 3		c	0					5.4	281
bt	mph	l	f		1 2 3		b	1	-	2 fm	2	fe stain	7.5	112
bt	mph	R	f		1 2 3		b	0					5.8	173
bt	mph	R	f		1 2 3		b	0					6.9	120
bt	mph	R	f		1 2 3		b	0		4 fm	3		8.1	121
bt	mph	r	u		1		b	-	-	-	-	-	0.7	112
bt	mph	l	f		1 2 3		b	-	-	-	-	-	9.5	53
bt	mph	R	f		1 2 3		b	0		3 km	1		6.3	281
bt	mph	R	f		1 2 3		b	0		2 km	3		7.5	120

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mph	R	f		1 2 3		b	0		6 km	3		6.1	188
bt	mph	R	f		1 2 3		b	0		2 km	3		7.5	615
bt	mph	R	f		1 2 3		b	0		1 km	3		5.4	284
bt	mph	L	fu		1 2 3		b	0					5.9	443
bt	mph	R	f		1 2 3		b	0					7.8	79
bt	mph	R	f		1 2 3		b	0					7.5	436
bt	mph	R	f		12 3		b	0		3 km	3		6.2	443
bt	mph	R	f		1 2 3		b	0					8.8	227
bt	mph	R	f		1 2 3		b	0					9.8	188
bt	mph	R	f		1 2 3		c	0					4.8	530
bt	mph	R	f		1 2 3		b	0					8	676
bt	mph	R	u		2 3		b	0					3.7	379
bt	mph	R	f		1 2 3		b	0		5 km	3		10.7	37
bt	mph	r	f		1 2 3		c	-	-	-	-	-	5.8	537
bt	mph	r	f		1 2 3		c	-	-	2 dm	1	-	6.7	112
bt	mph	r	f		1 2 3		b	-	-	-	-	-	7.1	112
bt	mph	r	f		1 2 3		b	-	-	4 fm	3	-	7.1	112
bt	mph	r	f		1 2 3		b	-	-	-	-	-	6.5	112
bt	mph	r	f		1 2 3		b	-	-	-	-	wkd?? / worn an	6.8	112
bt	mph	r	f		1 2 3		b	-	-	1 dm, 1 fm, 2 fm	1, 2, 3		7.4	112
bt	mph	r	f		1 2 3		b	-	pun	-	-	-	7.5	53
bt	mph	r	f		1 2 3		b	-	-	2 dm, 1 fm	1, 2		11.2	884
bt	mph	r	f		1 2 3		b	-	-	1 dm, 1 fm	1, 3	-	6.4	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mph	r	f		1 2 3		b	-	-	1 fm	3	-	8.6	53
bt	mph	l	f		1 2 3		b	-	2	2 fm	3	burnt	5.8	112
bt	mph	r	u		1		b	-	-	-	-	-	0.2	574
bt	mph	r	u		2 3		b	-	-	-	-	-	1.3	891
bt	mph	L	f		1 2 3		b	0					6.7	221
bt	mph	R	f		1 2 3		b	0					6.5	628
bt	mph	L	f		1	3	b	0				chopped tru 3, (	3.7	603
bt	mph	L	f		1 2 3		b	0		4 km	3		5.6	288
bt	mph	L	f		2 3		b	0					2.4	288
bt	mph	L	f		2 3		b	0					1.4	466
bt	mph	r	f		1 2 3		b	-	-	-	-	-	6.9	112
bt	mph	L	f		1 2 3		b	0					7.3	54
bt	mph	l	f		1 2 3		b	-	-	-	-	-	6.9	112
bt	mph	l	f		1 2 3		b	-	-	I km, 1 km	1, 3	-	7.3	112
bt	mph	l	f		1 2 3		b	-	-	-	-	cal	8.8	50
bt	mph	l	f		1 2 3		b	-	-	2 km	3	-	6.1	112
bt	mph	l	f		1 2 3		c	1	-	-	-	char	8.3	53
bt	mph	l	f		1 2 3		b	-	-	-	-	-	7.1	112
bt	mph	l	f		1 2 3		b	-	-	-	-	-	6.8	112
bt	mph	r	f		1 2 3		b	-	-	-	-	-	7.7	112
bt	mph	l	f		1 2 3		b	-	-	-	-	-	6.8	112
bt	mph	l	f		1 2 3		c	-	-	fm	3	-	7.7	50
bt	mph	l	f		1	3	b	-	-	-	-	-	1.8	129

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mph	l	u		2 3		b	-	-	-	-	-	1.9	261
bt	mph	l	u		2 3		b	-	-	-	-	-	1.3	58
bt	mph	l	u		1		b	-	-	-	-	-	1.5	379
bt	mph	l	u			1	b	-	-	-	-	-	0.4	112
bt	mph	l	f		1 2 3		b	-	-	-	-	-	5.5	112
bt	mt	r	f	n		2 6	c	0					4.3	199
bt	mt	-	n	n		7 8	b	0					7.3	114
bt	mt	-	n	n		7 8	b	0					3.7	344
bt	mt	-	n	u	$		c	4				burnt	6.4	112
bt	mt	-	n	u		$	c	0					5.3	112
bt	mt	l	f	f			b	0					94.9	112
bt	mt	r	f	u			c	0					37.4	112
bt	mt	-	n	f	$ £		c	0					12.7	53
bt	mt	-	n	u	$		c	4				burnt	5.9	112
bt	mt	-	n	u	$		c	0					5.1	112
bt	mt	-	n	u	£		c	0					8.7	64
bt	mt	-	n	u	$		b	0					5.5	284
bt	mt	l	f	n		1	b	3				burnt	2.8	748
bt	mt	l	n	u	3 4		c	0					18.1	53
bt	mt	L	n	n	5 6 7 8		b	0					9.5	188
bt	mt	l	n	n		5 7	c	0		20 fm	5 - 7	young	5	402
bt	mt	R	n	n	7 8	5 6	c	0					28	284
bt	mt	l	f	f			c	0		10 fm	6		93	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mt	l	f	f			c	0					87.1	112
bt	mt	r	f	n			c	0					26.5	112
bt	mt	r	f	n			c	0					16.4	112
bt	mt	r	n	f			c	0		4 fm, 5 fm	7, 8		24.6	431
bt	mt	r	n	f			c	0		4fm, 9fm, 1 cm	7, 8, 8		44.7	112
bt	mt	r	f	u			c	0					3.5	112
bt	mt	L	n	n		5 7	b	0					10.9	603
bt	mt	l	f	n		2 6	b	0					8.5	112
bt	mt	L	n	u		7 8	b	0					7	149
bt	mt	-	n	n		5 6 7 8	b	0					15	365
bt	mt	-	n	n		5 6 7 8	b	0					17.8	436
bt	mt	-	n	n		£	b	0					7.1	378
bt	mt	-	n	f	$		b	0					7.5	38
bt	mt	-	n	f	$		b	0					10	37
bt	mt	-	n	u	$		b	0					3	603
bt	mt	-	n	u	$		b	0					3.7	35
bt	mt	-	n	u	$		b	0					3.6	34
bt	mt	-	n	n	&		b	0					4.5	397
bt	mt	R	n	u		7 8	b	0		5 km	7 8		8.3	288
bt	mt	r	f	f			c	0					6.7	112
bt	mt	R	n	u		7 8	b	0					8.7	232
bt	mt	-	n	u		7 8	b	0					5.2	149
bt	mt	L	f	n		2 6	b	0					3.3	425

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mt	-	n	n		7 8	c	0					6.1	365
bt	mt	-	n	n		£	b	0					3	120
bt	mt	L	n	n	5 6 7 8		b	0					9.8	56
bt	mt	L	n	n		5 6 7 8	b	0		>30 fm	5 6 7 8		17.1	74
bt	mt	-	n	f	$	£	c	0					8.5	53
bt	mt	-	n	u	$		b	0					4.2	120
bt	mt	R	u	u	5 6 7 8		b	0					14.2	148
bt	mt	L	f	n		1 2 5 6	b	0					12.5	205
bt	mt	L	u	n	1 2	5 6	b	0					7.2	388
bt	mt	L	f	n	1 2	5 6	c	0					39.7	53
bt	mt	L	f	n	1 2	5 6	b	0					22.7	288
bt	mt	r	u	n		5 6	b	0		2 fm	6		3.5	881
bt	mt	L	u	u	5 6 7 8		b	0					18.5	284
bt	mt	r	f	u			c	0					3	112
bt	mt	R	n	f	3 4 7 8		c	0					34.9	615
bt	mt	R	u	u	5 6 7 8		b	0					16.4	199
bt	mt	R	f	n		1 2 5 6	b	0					27.8	188
bt	mt	R	f	n		1 5	b	0					4.2	620
bt	mt	R	f	n		1 5	b	0					14.5	226
bt	mt	R	n	n	5 6 7 8		b	0	gn				50.3	652
bt	mt	R	f	n	1 2	5 6	b	0		6 cm	5		26.1	99
bt	mt	R	f	f	1 2 3 4 5 6 7 8		b	0					85.5	20
bt	mt	r	f	f	1 2 3 4 5 6 7 8		c	0	gn				99.7	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	mt	R	u	u	5 6 7 8		b	0					17.7	628
bt	mt	r	f	f			c	0					63.3	112
bt	mt	L	f	n		1 2 5 6	b	0					7.5	205
bt	mt	R	n	n	7 8		c	0				water abraded	13.8	56
bt	mt	L	u	u	5 6 7 8		b	0					11.6	188
bt	mt	L	u	n	5 6 7 8		b	0					11.5	539
bt	mt	L	u	u	5 6 7 8		b	0		cm	6		9.9	626
bt	mt	L	f	n		1 5	b	0					3.3	378
bt	mt	r	f	f			c	0					5.7	112
bt	pe	R	f		1 2 3 4 5	6 8	b	0				nb	62	398
bt	pe	R	f		1 2 3 4 6 8		b	0					56.1	72
bt	pe	R	f		12 3 4 5	6 8	b	0					64.5	676
bt	pe	R	f		1 2 3 4	5 6	b	0				nb	49.4	63
bt	pe	R	f		2	4 6	b	0					24	423
bt	pe	R	f		3 8		b	0					19.8	61
bt	pe	R	f		3 8		b	0					13.2	344
bt	pe	R	f		3		b	0					5.6	423
bt	pe	R	f		3 8		b	0					11	510
bt	pe	R	f		1 2 3 4 5 6 8		b	0				burnt on 8	69	529
bt	pe	r	n		1 5		c	0		20+ kn	5		29.8	64
bt	pe	r	f	-	1 5 7 # @	2 4	c	0		1 cm	1		47.4	419
bt	pe	l	f	-	3 8	1	b	0					12.2	50
bt	pe	l	n	n	3 8		c	0					3.2	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	pe	l	f	-	1 2 3 8	5 6	b	0					42.258	53
bt	pe	l	f	-	1 2 3	6 8	b	0					46.6	50
bt	pe	l	n	-	1 5		b	0					42.4	60
bt	pe	R	f		2	1 6	b	0					11.2	34
bt	pph	R	f		1 2 3		b	0		3 km	3		10.3	288
bt	pph	L	f		1 2 3		b	0					15.2	20
bt	pph	R	f		1 2 3		b	0		3 km	3		11.2	112
bt	pph	R	f		1 2 3		c	0					10.6	528
bt	pph	R	f		1 2 3		b	0		3 km	3		12.3	112
bt	pph	R	f		1 2 3		b	0		4 ?km	3		11.8	114
bt	pph	R	f		1 2 3		b	0		3 km	3		13.3	120
bt	pph	R	f		1 2 3		b	0					20.7	221
bt	pph	R	f		1 2 3		b	0		2 km	3		15	229
bt	pph	R	f		1 2 3		b	0					10.8	625
bt	pph	R	f		1 2 3		b	0					11.5	77
bt	pph	R	u		2 3		b	0					3.6	288
bt	pph	R	f		1 2 3		b	0		4 km	3		8.9	112
bt	pph	R	f		1 2 3		b	0					12.4	288
bt	pph	R	f		1 2 3		b	0					14	147
bt	pph	R	f		1 2 3		b	0		2 km	3		12.8	120
bt	pph	R	f		1 2 3		b	0					8.6	38
bt	pph	R	f		1 2 3		b	0					11.8	97
bt	pph	R	f		1	2 3	b	0					6.1	363

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	pph	R	n		2	3	b	0					3.4	628
bt	pph	R	f		1 2 3		b	0					10.4	612
bt	pph	R	f		1 2 3		b	0					10.7	53
bt	pph	R	f		1 2 3		b	0					10.6	98
bt	pph	R	f		1 2 3		b	0					12.6	112
bt	pph	R	n			2 3	b	0					2.1	228
bt	pph	R	f		1 2 3		c	0					11.1	529
bt	pph	R	f		1 2 3		b	0					10	284
bt	pph	R	f		1 2 3		b	0					12.5	429
bt	pph	R	f		1 2 3		b	0					16.1	120
bt	pph	R	f		1 2 3		b	0		8 dm	3		14.5	363
bt	pph	L	f		1 2 3		b	0					9.1	281
bt	pph	R	f		1 2 3		b	0		5 km	3		11.1	281
bt	pph	L	f		1 2 3		b	0					18.7	219
bt	pph	R	f		1 2 3		c	0					12.2	285
bt	pph	R	f		1 2 3		b	0					13.2	56
bt	pph	R	f		1 2 3		b	0		4 km	3		9.7	112
bt	pph	R	n		2	3	b	0					3.7	34
bt	pph	R	n		2	3	b	0					3.4	425
bt	pph	R	n		2	3	b	0		2 km	3		3.2	112
bt	pph	R	f		1	3	b	0					2.6	635
bt	pph	R	u		2 3		b	0					5.3	188
bt	pph	R	n			2 3	b	0					2	603

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	pph	R	f		1 2 3		b	0					11.7	120
bt	pph	l	f	f	1 2 3		c	0					13.5	50
bt	pph	r	u	f	1		c	0					1.4	112
bt	pph	l	u	f	2 3		b	0					4.4	112
bt	pph	l	f	n	1	3	b	4				burnt	7.5	863
bt	pph	l	f	f	1 2 3		c	0					11.4	112
bt	pph	l	f	f	1 2 3		c	0					11.3	112
bt	pph	l	u	f	2 3		b	0					4.5	112
bt	pph	l	f	f	1 2 3		b	0					14	112
bt	pph	l	u	n	1		b	0					1.6	112
bt	pph	l	f	f	1 2 3		b	0		3 dm	3		11.3	112
bt	pph	l	f	f	1 2 3		b	0		2 dm	3		11.6	112
bt	pph	l	f	f	1 2 3		c	0		3 dm	3		10.1	112
bt	pph	l	f	f	1 2 3		b	0					11.4	112
bt	pph	l	f	f	1 3	2	b	0					7.1	454
bt	pph	r	u	n	1		c	0					1	112
bt	pph	l	f	f	1 2 3		c	0		2 dm, 8 fm	3, 3		11.8	112
bt	pph	l	n	f		2 3	b	0					1.2	288
bt	pph	r	f	f	1 2 3		b	0					12.9	53
bt	pph	r	f	f	1 2 3		b	0	-	5 dm	3		12.3	112
bt	pph	r	f	f	1 2 3		b	0		17dm	3		12.2	112
bt	pph	r	f	f	1 2 3		b	0					14.8	53
bt	pph	l	u	f	2 3		b	0					2.7	315

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	pph	l	u	n	1		c	0					1.5	112
bt	pph	l	f	n	1	3	b	4				burnt	6.1	280
bt	pph	l	f	f	1 2 3		b	0					11.4	50
bt	pph	l	u	n	1		b	0					0.7	250
bt	pph	l	u	n	1		b	0					1	261
bt	pph	l	n	f		2 3	c	4				burnt	2.2	863
bt	pph	l	n	f		2 3	c	4				burnt	2.1	115
bt	pph	l	n	f		2 3	c	0		8 fm	3		2.8	112
bt	pph	l	n	f		2 3	c	4				burnt	2.1	112
bt	pph	l	u	-	1		b	0					0.9	315
bt	pph	r	f	f	1 2 3		b	0		3 dm	3		10.9	112
bt	pph	r	f	f	1 2 3		c	0		2 dm	3		12.9	53
bt	pph	l	f	f	1 2 3		c	0					12.5	112
bt	pph	r	f	f	2 3	1	b	1		5 dm	3	burnt	8.8	112
bt	pph	r	f	f	1 2 3		c	0		2 dm	3		15.3	884
bt	pph	r	f	f	1 2 3		c	0		3 dm	3	lge punc	10	112
bt	pph	r	f	f	1 2 3		b	0					10.7	112
bt	pph	r	f	-	1	3	b	2				burnt	6	863
bt	pph	r	f	f	1 2 3		b	0		1 dm, 3 chop	1, 3		11.2	112
bt	pph	r	u	f	2 3		c	0					4.3	112
bt	pph	r	-	f		2 3	c	0					2.5	221
bt	pph	r	-	f	2	3	c	0					3.1	58
bt	pph	r	f	f	1 2 3		b	0					12.1	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	pph	r	-	f	2	3	c	0		1 dm	3		3.7	53
bt	ra	L	n	u	3 4		c	0		-			5.7	205
bt	ra	R	n	n	3 4 9 #	8	b	0		-		-	53.3	677
bt	ra	R	n	f	J 3 4 8 9 #		a	0		-		-	70.1	97
bt	ra	R	n	f	J 3 4 8 9 #		b	0		-		-	69.5	64
bt	ra	L	f	n	2	5	b	0					9.5	281
bt	ra	R	f	n	1 2	5	b	0					17.1	199
bt	ra	R	f	n		2 5	b	0					10.4	653
bt	ra	L	u	u	#	8 9	c	0		-			7.8	461
bt	ra	R	f	n		2 5	b	0					24.3	149
bt	ra	L	n	u	J 3 4		b	0		-			37.6	397
bt	ra	R	u	n	5 6 7 8		b	0	gn	-			8.2	638
bt	ra	R	u	u	1 2 5 6 7 8 9 #		b	0		-			12.4	378
bt	ra	R	f	u	1 2 5 6 7 8 9 #		b	0		-			20.8	653
bt	ra	R	fu	u	1 2 5 6 7 8 9 #		b	0		-			25.8	78
bt	ra	R	u	u	5 6 7 8 9		b	0		-		-	13.9	120
bt	ra	L	n	f	J 3 4 9 #		b	0		-		SF 198	34.8	658
bt	ra	R	n	-	J	3	c	0		-		> 3.5 - 4 yrs	5.1	98
bt	ra	L	n	u	7 8 9 #	6	a	0		-			12.1	182
bt	ra	L	n	f	J 3 4 9 #	9	b	0	gn 1	-			36.8	188
bt	ra	L	n	u	9 #	6 7 8	b	0		-		gnawed, fuses w	14.2	205
bt	ra	L	f	n	1 2	5	c	0		-			21.8	37
bt	ra	L	f	u	1 2 5 6 7 8 9 #		b	0		-			75.4	97

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	ra	L	u	u	1 2 5 6 7 8	9 #	b	0		-			9	121
bt	ra	L	u	u	1 2 5 6 7 8 9 #		c	0		2 poss filleting on 6			10.5	429
bt	ra	R	f	n	1 2	5	b	0		-		-	38.7	378
bt	ra	L	n	u	9 #	6 7 8	b	0		fill / dism on 6			80.2	641
bt	ra	R	f	n	1 2	5 6	b	0					21.3	56
bt	ra	L	n	u	3 4		c	0		-			4.6	461
bt	ra	L	n	f	J 3 4 8 9 #		c	0		-			51.3	9
bt	ra	R	fu	n	1 2	5	b	0					8.1	79
bt	ra	r	n	n		6	c	0					6.4	53
bt	ra	L	n	f	J 3 4	#	b	0		-			14.6	20
bt	sc	R	f	f	1 2 3 4 5	7	b	0					83	397
bt	sc	L	f	n	1 2	5	b	0					7.2	38
bt	sc	l	f	-		2 3	b	0					7.8	221
bt	sc	R	f	f	1 2 3 5	7 9	b	0					95.7	148
bt	sc	L	f	f	1 2 3 4 5	6 7	b	0		fm?	2		99.1	653
bt	sc	L	f	f	1 2 3 4 5 6	7	b	0		7 fm	med 4		65.4	79
bt	sc	L	f	f	1 2 3 5	4	b	0					40.7	482
bt	sc	L	f	f	1 2 3 4 5		b	0					40 3	677
bt	sc	L	f	f	1 2 3	4 5	b	0					14.9	628
bt	sc	L	f	n	1 2 3	5	b	0					18.5	378
bt	tb	L	n	f	5 6 #		b	0					75.2	56
bt	tb	L	n	u	6	5	b	0					11.7	149
bt	tb	l	n	u		#	c	0					5.8	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	tb	l	f	n		2 7	c	0					4.4	9
bt	tb	R	u	u	7 8 9 #		b	0					25.1	620
bt	tb	L	n	f	6	5 #	b	0		cm, chv,	5		11.6	35
bt	tb	L	n	u	5 6		b	0					4.2	533
bt	tb	L	n	f	5 6	#	b	0					26.7	121
bt	tb	L	n	n		7 8	b	0					40.5	363
bt	tb	r	n	n		#	b	0					13.7	288
bt	tb	L	n	n	5		b	0					2.6	402
bt	tb	L	f	n	1 2 3 4 7 8		b	0					143.5	61
bt	tb	L	f	n	1 2 3 4	7	b	0					80.3	149
bt	tb	L	u	n	7	8	b	0		4 fm	7	choppedthru	83.9	280
bt	tb	L	u	n	1 2 3 4		b	0	0	14 fm/dm	4		31.3	280
bt	tb	L	n	n		7 8	b	0	gn				49.1	56
bt	tb	l	n	f	5	#	b	0					7.6	315
bt	tb	r	a	u	5 6		b	0					7.9	112
bt	tb	l	n	f	5 6	#	b	0					49.1	53
bt	tb	r	n	n		7	b	0					17.7	620
bt	tb	R	u	u	7 8 9 #		b	0					23.9	472
bt	tb	L	u	u	7 8 9 #		b	0					21	620
bt	tb	L	u	u	7 8 9 #		b	0					25.4	603
bt	tb	R	u	n	7		b	0					4.2	355
bt	tb	R	n	n		7 8	b	0					35.5	365
bt	tb	R	f	n	1 2 3 4 7	8	b	0		2 fm	7		79.9	397

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	tb	R	n	f	5 6	#	b	0					21.9	365
bt	tb	l	n	n		7	b	0					13.3	466
bt	tb	R	n	f	5 6	#	b	0					18.6	423
bt	tb	L	f	n	1	7	b	0					15.3	56
bt	tb	R	f	u	1 2 3 4 7		b	0					50.9	97
bt	tb	L	u	u	7 8 9 #		b	0					17.5	378
bt	tb	l	n	n		7	b	0					19.7	53.1
bt	tb	r	n	n		7	c	0					9	56
bt	tb	l	n	n	7 8		c	0					46.1	87
bt	tb	l	n	n	8	7 9	b	0					46.6	112
bt	tb	R	u	u	7 8 9 #		b	0					17.6	436
bt	tb	R	u	u	7 8 9 #		b	0					18.5	676
bt	tb	l	n	f	5 6 #	9	b	0					63	112
bt	tb	l	n	f	6	5 #	b	0					19.6	315
bt	tb	L	n	u	9 #		c	0					36.2	281
bt	ul	R	f	-	A B C D		c	0		cm	C		27.9	281
bt	ul	R	n	-	C D	B E	b	0		-			18.3	54
bt	ul	R	f	-	A B C D	E	b	0		-			32.9	397
bt	ul	L	n	n	B C D	E	b	0		-			30.8	615
bt	ul	L	n	n	B C D E		b	0					15.7	199
bt	ul	R	u	n	B C D E	F	b	0					7	365
bt	ul	R	n	n		A	b	0					2	378
bt	ul	R	n	n	A B		b	0					12.2	529

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
bt	ul	L	n	n	E F	G	c	0		-		-	3	539
bt	ul	R	n	n	D E	D E	b	0					5.1	79
bt	ul	R	f	-	A B C D E		b	0		-		-	38.8	653
bt	ul	R	n	n		C	b	0					5.2	112
bt?	ep	-		n		1	c	0					5.3	149
bt?	ra	L	n	n	-	6 8	b	0		-		-	14	658
bt?	sc	R	u	u	2 3 4 5 7		b	0					10.3	209
bt?	sc	R	u	u	2 3 4 5 6 7		b	0					13.2	620
bt?	sc	R	u	u	2 3 4 5 6 7 9		b	0					9.4	74
bt?	ul	R	u	-	B C D E	F	a	0		-		Neonatal	5.2	329
bt?	ul	L	u	-	B C D E	F	d	0		-		Neonatal	6.3	284
bt?	ul	R	u	-	B C D E	-	c	0		-		Neonatal	3.7	175
car	fe	R	u	u	2 3 5 6 7 8		b	0					2.8	121
cc	mt	R	f	n		2 6	b	0					6.9	121
ce	ast	L			1 2	3 4	b	0					8	86
ce	ast	L			1 2 3 4		b	0					19.5	98
ce	ast	L			1 2 3 4		b	0					14.2	63
ce	ast	L			1 2 3 4		b	0		1	3		14.2	439
ce	ast	L			1 2 3 4		b	0					22.9	34
ce	ast	L			1 2 3 4		b	0					11.3	34
ce	ast	L			1 2 3 4		b	0					18.1	98
ce	ast	L			1 2 3 4		b	0					14.9	37
ce	ast	L			1 2 3 4		b	0					16.7	121

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	ast	R			1 2 3 4		b	0					13.3	329
ce	ast	R			1 2 3 4		b	0					17.3	435
ce	ast	R			1 2 3 4		b	0		1 dm, 5 dm	1, 2		13.3	388
ce	ast	R			1 2 3 4		b	0					14.5	98
ce	ast	R			1 2 3 4		b	0					12.9	101
ce	ast	R			1 2 3 4		b	0					14.9	98
ce	ast	R			1 2 3 4		b	0					19.8	365
ce	ast	R			1 2 3 4		b	0					14.5	234
ce	ast	R			1 2	3 4	b	0					12	98
ce	ast	R			1 2 3 4		b	0		5 dm, 2 dm, 2 dm	2, 3, 4		11.2	40
ce	ast	r	-	-	1 2		c	0					1.6	60
ce	ast	L			1 2 3 4		b	0					19.7	98
ce	ast	r	-	-	1 3 4	2	b	0					11.8	53
ce	ast	l	-	-	1 2 3 4		c	0	gn	1 cm, 1 cm	3, 4		15.1	50
ce	ast	R			1 2 3 4		c	0					12.6	96
ce	at	-		f		1 2	b	0					12.5	61
ce	at	-		f	1 2		b	0					15.8	34.3
ce	cal	L	u		2 3 4 5		c	0					6.4	51
ce	cal	R	n		2 3 4 5		b	0					19.4	61
ce	cal	R	u		2 3 4 5		b	0					17.3	101
ce	cal	R	n		2 3 4 5		b	0					23.8	190
ce	cal	r	u	-	2 3 4 5		b	0					21.8	53
ce	cal	R	u		2 3 4 5		b	0					29	98

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	cal	R	f		1 2 3 4 5		b	0					19.4	188
ce	cal	R	n		2 3 4 5		c	0					13.9	96
ce	cal	R	n		4 5		b	0					5.1	86
ce	cal	R	u		2 3 4 5		b	0					18.5	98
ce	cal	L	u		2 3 4 5		b	0					10.7	101
ce	cal	L	f		1 2 3 4 5		c	0					18.5	23
ce	cal	L	f		1 2 3 4 5		b	0					30.1	98
ce	cal	L	u		2 3 4 5		b	0					28	98
ce	cal	L	n		4 5		b	0					3.4	35
ce	cal	r	u	-	2 3 4 5		b	0					10	64
ce	cal	R	f		1 2 3 4 5		b	0					29	363
ce	cal	R	f		1 2 3 4 5		b	0					29.2	188
ce	cal	r	u	-	1		b	0					2.4	53
ce	dph	L	f		1 2		b	0					1.6	365
ce	dph	R	f		1 2		b	0					2.9	388
ce	dph	L	f		1 2		b	0					6	98
ce	dph	L	f		1 2		b	0					4.5	284
ce	dph	R	f		1 2		b	0					3.3	39
ce	dph	R	f		1 2		b	0					5	98
ce	dph	L	f		1 2		b	0					3.6	101
ce	dph	R	f		1 2		b	0					3.4	56
ce	dph	l			1 2		b	-	-	-	-	-	4.3	379
ce	dph	l			1 2		b	-	-	3 dm, 1 km	1, 2	-	3.3	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	dph	l			1 2		b	-	-	2 dm	1	-	3.2	112
ce	dph	l			1 2		b	-	-	-	-	-	5.1	107
ce	dph	R	f		1 2		b	0					4.3	98
ce	dph	r			1 2		b	-	-	-	-	-	3.1	112
ce	ep	-		n		1	c	0					1.8	653
ce	fe	l	n	n	7 8	6	b	0					11.1	53
ce	fe	r	f	n	2	3	b	0					5.8	61
ce	fe	r	n	f	9 # @	7 8	b	0					59.8	60
ce	fe	l	n	f	9 # @	7 8	b	0					45.9	60
ce	fe	L	f	n	1 2 3 4 5		b	0					37.3	61
ce	fe	l	n	f	7 8 9 # @		b	0					70.9	53
ce	fe	R	f	n	2 4 5	3	b	0					18.6	53
ce	fe	l	f	n	2 4 5	1 3	b	0					30.8	53
ce	fe	l	f	n	2		b	0					2.6	188
ce	fe	l	n	n	2 3 6		b	0					22.653	50
ce	fe	l	n	n		7 8	b	0					16.5	53
ce	fe	R	n	n	7 8		b	0					27	61
ce	fe	l	u	n		7	c	4				burnt	3.1	112
ce	fe	L	f	n	1 3 4 5	2	b	0					31.1	364
ce	fe	L	n	f	9 # @	7 8	b	0					57.4	227
ce	fe	l	n	f	9 # @	7 8	c	0					45.4	53
ce	fe	R	n	f	9 # @	7 8	c	0					31	9
ce	hu	R	n	f	3 4 5 6	7 8	c	0					27.1	120

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	hu	R	n	f	3 4 5 6	7 8	b	0					29.6	101
ce	hu	R	n	f	3 4 5 6 7 8	9 #	b	0					39.7	123
ce	hu	L	f	n	1 2	@	b	0					27.6	209
ce	hu	R	u	n	1 2		b	0					12.4	123
ce	hu	R	u	n	@		b	0		? km	@		22.4	123
ce	hu	L	n	f	3 4 5 6	7 8	b	0					28.4	114
ce	hu	L	n	f	3 4 5 6 7 8		b	0					49.5	363
ce	hu	R	n	f	3 4 5 6	7 8	b	0					22.5	173
ce	hu	R	n	f	3 4 5 6	7 8	b	0					23.2	284
ce	hu	R	n	f	4 6	3 5 7 8	b	0					3	653
ce	hu	R	f	n	1 2 @		b	0					33.8	122
ce	hu	R	n	f	3 4 5 6 7 8	9 #	c	0					10	98
ce	hu	R	n	f	3 4 5 6	7 8	c	0	gn				39.5	39
ce	hu	R	n	f	3 4 5 6	7 8	c	0					40.3	329
ce	hu	R	n	f	3 4 5 6	7 8	b	0		2 ? km	7		37.1	653
ce	hu	R	f	n	1 2	@	b	0					23.2	364
ce	mc	-	n	n		5 6 7 8	b	0	? rd	2 -12 fm, 4 ? fm			10.1	56
ce	mc	L	n	f	3 4	7 8	b	0					15.2	99
ce	mc	r	n	n		5 6	b	0					12.6	120
ce	mc	-	n	n		5 6 7 8	b	0					11.6	34
ce	mc	l	n	n		5 6	c	0					4.7	53
ce	mc	L	n	f	3 4	7 8	b	0					14.1	34
ce	mc	-	n	n	5 6		b	0					3.1	39

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	mc	L	n	f	3 4	7 8	c	0					14.1	34
ce	mc	R	f	n		1 2 5 6	b	0					4.3	50
ce	mc	R	f	n	1 2	5 6	b	0					23.7	99
ce	mc	-	n	n		5 6	b	0					11	508
ce	mc	R	f	n	1 2	5 6	b	0					6.8	39
ce	mc	R	n	f	3 4	7 8	b	0					12	173
ce	mc	R	f	n	1	5	b	0					3.1	427
ce	mc	-	n	f	3 4	7 8	b	0					14.1	237
ce	mc	L	f	n	1 2 5	6	b	0					11.2	37
ce	mc	l	f	n		2	c	1				burnt	2.6	885
ce	mc	L	f	n	1 2 5 6		b	0					40	101
ce	mc	L	f	n	1 2	5 6	b	0					11.8	101
ce	mc	-	n	u	£		b	0					2	39
ce	mc	R	n	f	3 4	7 8	b	0					8.5	96
ce	mc	-	n	n		5 6 7 8	b	0					8.6	852
ce	mc	R	n	n		£	b	0					1.8	653
ce	mc	-	n	n		5 6 7 8	b	0					4.3	120
ce	mc	R	f	n	1 2	5 6	c	0					16	97
ce	mc	R	f	n	1	2 5 6	c	0					9.7	34
ce	mc	-	n	n		7 8	b	0					5.3	180
ce	mc	R	n	u	3 4		b	0					6	86
ce	mc	L	f	n	1 2	5 6	b	0					6.5	56
ce	mp	-	n	n		3 4	b	0					3.3	363

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	mph	R	u		2 3		b	0					1.1	120
ce	mph	l	f		1	3	a	-	-	-	-	-	3.1	632
ce	mph	l	f		1	3	a	-	-	-	-	-	2.1	361
ce	mph	R	f		1 2 3		b	0		3 km	3		7.3	101
ce	mph	L	u		1		b	0					0.3	625
ce	mph	R	f		1 2 3		b	0					6	98
ce	mph	R	f		1 2 3		b	0					6.1	101
ce	mph	R	n			2 3	b	0					1.9	616
ce	mph	R	n			2 3	b	0					1.5	12
ce	mph	R	n		2	3	b	0					2.1	423
ce	mph	R	f		1	3	b	0					2.1	34
ce	mph	R	n		2 3		b	0					1.1	329
ce	mph	R	u		2 3		b	0					1.2	402
ce	mph	R	u		1		b	0					2.4	98
ce	mph	L	f		1 2 3		b	0		3 km	3		7.9	98
ce	mph	L	u		1		b	0					0.5	466
ce	mph	L	u		1		c	0					0.8	603
ce	mph	L	n		2	3	c	0					1	95
ce	mph	L	n		2	3	b	0					1.6	364
ce	mph	R	u		1		b	0					1.9	98
ce	mph	L	u		2 3		b	0					1	620
ce	mph	r	u		2 3		c	-	-	-	-	-	0.7	58
ce	mph	L	f		1 2 3		b	0		1 ?km	3		5.5	101

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	mph	L	f		1 2 3		b	0		6 km	3		7.4	188
ce	mph	L	f		1 2 3		b	0					5.5	149
ce	mph	L	f		1 2 3		b	0		1 km	3		5.3	34
ce	mph	R	u		2 3		c	0					0.8	472
ce	mph	R	u		1		b	0					0.9	120
ce	mph	L	u		2 3		c	0					1.9	378
ce	mt	L	n	n		5 6	b	0					5.3	60
ce	mt	R	f	n	1 2	5 6	b	0					8.6	54
ce	mt	L	f	n		1 2 5 6	c	0		km	5		8.7	93
ce	mt	L	n	f	3 4	7 8	c	0		? btch	lat & post 7		14.3	612
ce	mt	L	f	n	2	6	b	0					8.7	61
ce	mt	L	f	n	1 2	5 6	b	0					12.9	56
ce	mt	L	f	n	1	5	b	0					4.3	508
ce	mt	L	f	n	1 2	5 6	b	0					19.9	34
ce	mt	L	f	n	1 2	5 6	b	0					13.3	54
ce	mt	L	f	n	1 2	5 6	b	0					15.8	97
ce	mt	L	f	n	1 2 6	5 8	b	0					27.4	188
ce	mt	R	n	u	7 8		b	0					16.3	114
ce	mt	-	n	n		5 6	b	0					2	98
ce	mt	R	f	n	1 2	5 6	c	0				(057??)	15.8	97
ce	mt	L	f	n	1 2	5 6	b	0					9.8	129
ce	mt	R	n	f	3 4	7 8	b	0					17.2	149
ce	mt	R	n	f	3 4	7 8	c	0		dm	7/8		20.7	40

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	mt	R	n	f	3 4	7 8	b	0					16.3	56
ce	mt	R	n	f	3 4 7 8		b	0					35.4	35
ce	mt	R	f	n		1 5 6 7	b	0					14.7	288
ce	mt	R	f	n		1 2 5 6	b	0					7.3	37
ce	mt	R	f	n		1 2 5 6	b	0					6.1	35
ce	mt	R	f	n	2	1 5 6	b	0					5.3	35
ce	mt	R	f	n		1 2 5 6	b	0					16	56
ce	mt	R	f	n	1 2 5 6		b	0					37.2	61
ce	mt	R	f	n	1	2 5	b	0					5	607
ce	mt	R	n	n		4 6	b	0					6.2	123
ce	mt	r	n	f	3 4	7 8	c	0					16.6	53
ce	mt	l	n	n		5 6	c	0					6.5	39.2
ce	mt	R	f	n		1 5	b	0					1.8	121
ce	mt	-	n	n		7 8	b	0		5 km	£		10.9	34
ce	mt	-	n	n		& £	b	0					3.6	99
ce	mt	L	n	n		5 6 7 8	b	0					5.4	98
ce	mt	R	n	n		5 7	b	0					8.4	97
ce	mt	L	n	n		7	b	0					8.2	123
ce	mt	R	n	n		5 6	b	0					8.7	35
ce	mt	R	n	n		5 6 7 8	b	0					11.4	101
ce	mt	L	n	n		5 6 7 8	b	0					13.7	188
ce	mt	R	n	n		5 6 7 8	b	0					18.9	1000
ce	mt	L	n	n		5 6 7 8	b	0					12.4	378

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	mt	-	n	n	£	£	b	0					6.2	97
ce	mt	R	n	u	8	7	b	0					7.6	56
ce	mt	L	n	n		5 6 7 8	b	0					6.1	120
ce	mt	R	n	n		5 6 7 8	b	0					19.9	53
ce	mt	-	n	f	3 (or 4)	7 (or 8)	b	0					5.1	61
ce	mt	L	n	f	3 7		b	0					12.5	365
ce	mt	R	f	n		1 2 5 6	b	0					6.1	66
ce	mt	L	f	n		1 2 5 6	b	0					9	129
ce	mt	L	f	n		1 2 5 6	b	0					8.6	98
ce	mt	L	n	f	4	7 8	b	0					10.1	37
ce	mt	-	n	n		& £	c	0					4.2	96
ce	mt	L	n	n		5 6	d	0				water-worn or di	8.8	61
ce	mt	r	n	n		5 6	b	0					4.9	53
ce	mt	-	n	u		£	b	0					2.5	56
ce	mt	-	n	n		5 6	b	0					7.7	61
ce	mt	l	f	n		1 2 5 6	c	0					5.4	64
ce	mt	-	n	n		5 6	b	0					3.6	54.4
ce	mt	r	f	n	2	6	b	0					3.8	50
ce	mt	r	n	n		5	b	0		5 fm	5		9.6	163
ce	pe	L	f	f	3 8	2	b	0					5	120
ce	pe	r	n	-	1 5		b	0					13.9	50
ce	pe	r	n	-	3	8	b	0					3.3	53
ce	pe	r	n	-	1 5	4	b	0					10.4	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	pe	l	n	-	1	4 5	b	0					3.5	650
ce	pe	l	f	-	3 8		b	0		3 km	8		1.7	53
ce	pe	l	f	-	1	3	b	0					1.6	64
ce	pe	l	f	-	1 2 3 6 8	4	b	0					18.6	58
ce	pe	l	f	-	1 2 4 5 6		b	0					12.6	53
ce	pe	r	f	-	1 2 3 4 6	5	c	0					24.3	53
ce	pe	L	n	n	1 5 #	4	b	0					13.1	173
ce	pe	L	f	u	1 4 5 #	7	b	0					31.9	122
ce	pe	L	f		1 2 4 5 6		b	0					31	56
ce	pe	L	n		1	5	b	0					2.4	78
ce	pe	L	f		1 2 4 6	5 @	b	0					21.6	34
ce	pe	R	n		2 6	@	b	0					10.1	218
ce	pe	r	f	-	1 2	4 5	b	0					5.3	53
ce	pe	l	f		1 5	4 7 #	c	0					16.4	53
ce	pe	l	n	-		1 5	b	0					2.1	53
ce	pe	l	n	-	1	5	b	0					5.1	441
ce	pe	R	u		1 5	7 #	b	0					8.4	56
ce	pph	L	f		1 3	2	b	0					8.5	121
ce	pph	L	n		2	3	b	0					2	34
ce	pph	L	u		2 3		b	0					3.9	120
ce	pph	L	u		1		b	0					1.5	482
ce	pph	L	f		1	3	c	0					1.5	96
ce	pph	R	f		1 2 3		b	0					9	37

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	pph	r	f	f	1 2 3		b	0					6.9	53
ce	pph	R	f		1 2 3		b	0					8.3	39
ce	pph	R	f		1 2 3		b	0					8.6	98
ce	pph	R	f		1 2 3		b	0					9.4	120
ce	pph	R	n		2	3	b	0					2.1	56
ce	pph	R	f		1	3	b	0					2.6	615
ce	pph	L	f		1	3	b	0					2.4	121
ce	pph	R	f		1	3	b	0					3.5	61
ce	pph	r	f	f	1 2 3		c	0		5 dm	3		7.5	50
ce	pph	R	f		1	3	b	0					2	34
ce	pph	R	n		2	3	b	0					4.3	129
ce	pph	R	f		1	3	b	0					2.3	20
ce	pph	R	n		2	3	b	0					3	34
ce	pph	r	n	-		2	c	0					1.1	112
ce	pph	r	n	-		2	b	0					1.9	439
ce	pph	R	f		1	3	b	0					2.5	129
ce	pph	R	n		2	3	b	0					4.3	20
ce	pph	L	f		1 2 3		b	0					8.9	98
ce	pph	L	f		1 2 3		b	0					9.6	101
ce	pph	l	f	n	2	3	b	0		1 kn	3		2.8	632
ce	pph	l	f	f	1 2 3		b	0					7.3	50
ce	pph	R	f		1	3	b	0					3.4	72
ce	pph	L	f		1	3	b	0					2.7	91

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	pph	L	f		1 2 3		b	0		1 km	3		7	378
ce	pph	L	f		1	3	b	0					2.4	120
ce	pph	L	n		2	3	b	0					1.8	120
ce	ra	L	f	n	1 2	5	b	0		-		-	16.7	363
ce	ra	L	f	n	1 2	5	c	0		-		-	12.7	56
ce	ra	L	f	n	1 2	5	b	0		-		-	13.6	101
ce	ra	l	n	n		8	b	4		4 fm	8		10.8	112
ce	ra	R	f	n	1 2	5	b	0		-			12.8	121
ce	ra	L	f	n	1 2	5	c	0		-		-	19.6	56
ce	ra	R	f	n	1 2	5	b	0		-			13.2	39
ce	ra	L	n	f	3 4 9 #		c	0		-		-	24.1	54
ce	ra	R	f	n	1 2 5	6 7 8	b	0		poss dism	1		43.9	438
ce	ra	l	n	n	6	7	b	0					5	50
ce	ra	R	n	n		4	b	0		-			1.9	38
ce	ra	R	f	n	1	2 5	b	0		-			7.7	54
ce	ra	R	n	f	3 4 9 #	8	b	0	gn	-			25.2	612
ce	ra	R	n	u	9 #	8	b	0	gn	-			17.3	56
ce	ra	L	f	n	1	5	b	0		-		-	5.8	101
ce	ra	R	n	n		6	b	0		-			10.9	158
ce	ra	R	n	f	3 4 9 #	8	b	0		-			23.8	37
ce	ra	R	u	u	5 6 7 8 9 #		b	0		-			9.5	365
ce	ra	R	n	f	3 4 #	9	b	0		-			16.2	135
ce	ra	L	n	u	3	4	b	0		-			3.8	315

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	ra	L	n	u	3 4		b	0		-		-	11.5	98
ce	ra	L	n	f	3 4 9 #		b	0		-		-	22	61
ce	ra	L	u	n		5	b	0		-		-	2.5	423
ce	ra	R	f	n	1 2	5	c	0		-			15.6	200
ce	ra	L	f	n	1 2	5	b	0		-		-	8.6	127
ce	ra	L	f	n	2	5	b	0		-		-	7.6	653
ce	ra	L	f	n	1 2	5	b	0		-		-	13.5	276
ce	ra	L	n	f	3	4	b	0		-		-	10	364
ce	ra	L	n	u	3 4 8 9 # J	-	b	0		-		-	7.7	423
ce	ra	L	n	f	3 4 9 #	8	c	1		-		-	24.8	120
ce	sc	R	f	f	2 3 4 5	7 8	b	0					17.9	83
ce	sc	L	f	f	1 2 3 4 5		b	0					18.7	98
ce	sc	R	f	u	2 3 4 5	6 7	b	0					19.2	53
ce	sc	R	f	f	1 2 3 4 5	6 7	b	0					25.5	120
ce	sc	L	f	f	1 2 3 4 5		b	0					14.8	120
ce	sc	R	f	n	2 3 4 5	6 7	b	0					15.5	61
ce	sc	L	f	u	2 3 4 5	7	b	0					13.6	61
ce	sc	R	f	f	2 3 4 5	1 7	b	0					17.7	56
ce	tb	L	n	f	5 6 #		b	0					12.7	34
ce	tb	L	n	f	5 6	#	b	0					15.1	26
ce	tb	l	u	n	3	4	c	0					2.9	53
ce	tb	L	n	f	5 6 #		b	0					22.1	98
ce	tb	L	n	f	5 6 #		b	0					24.8	129

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	tb	L	n	f	5 6 #		b	0					27.3	363
ce	tb	L	n	f	5 6	#	b	0					15.9	56
ce	tb	L	n	f	5 6 #		b	0					17.8	99
ce	tb	L	n	f	5 6 #		b	0					21	397
ce	tb	R	n	n	7	8 9	b	0					34	12
ce	tb	R	u	n	4		b	0					3.4	188
ce	tb	r	n	n		7	b	1					3.6	873
ce	tb	R	n	n		7 8	b	0					22.9	129
ce	tb	L	n	f	5 6 #		b	0					26.3	120
ce	tb	R	n	n	7	8	b	0					28.5	355
ce	tb	R	n	n		7	b	0					9.6	37
ce	tb	R	n	n		7 8	b	0					15.8	48
ce	tb	R	fu	n	4	7	b	0					10.3	380
ce	tb	R	f	n	1	7	b	0					7.4	96
ce	tb	R	f	n	1 2	3 4	b	0					16.3	276
ce	tb	L	n	n		7 8 9	b	0					34.9	383
ce	tb	r	f	n	4		b	0					4.3	315
ce	tb	l	fu			7	d	0					11.9	9
ce	tb	l	f	n		4 7	b	0					1.4	435
ce	tb	l	f	n	2 7	1 3	c	0					32.2	53
ce	tb	r	f	n	1 2 3 7		c	0					11.6	53
ce	tb	r	n	f	5 6 #		c	0					21.9	53
ce	tb	l	n	f	6	5 #	b	0					11.9	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	tb	R	n	u		#	b	0					6.4	54
ce	tb	R	n	fu	5 6 #	9	b	0					21.1	101
ce	tb	L	fu	n	1 2 3 4 7		b	0					46.4	56
ce	tb	L	f	n	1 2 3 4 7	8	b	0					72.9	86
ce	tb	R	n	f	5 6	#	b	0					18.5	149
ce	tb	R	n	f	5 6	#	b	0		cm	#		15.7	54
ce	tb	R	n	f	5 6 #		b	0					22.5	63
ce	tb	R	n	f	5 6 #		b	0					26.9	98
ce	tb	R	n	f	5 6 #		c	0					16.3	98
ce	tb	R	u	n	7	8	b	0					6.6	438
ce	tb	R	n	f	5 6 #		b	0					26.3	98
ce	tb	L	f	n	1 2 3	4 7	b	0					27.9	74
ce	tb	R	n	fu	5 6	#	b	0					7.1	12
ce	tb	L	u	n	1 2	3 4	b	0					5.1	98
ce	tb	R	f	n	1 2 3 4	7	b	0					45	122
ce	tb	L	f	n	1 2 3 4	7	b	0		6 cm	3		30	397
ce	tb	R	u	n	7		b	0					26.9	188
ce	tb	R	u	n	1 2 3	4	b	0		6 km	3		13.9	188
ce	tb	R	f	n	3 4 7		b	0					32.2	149
ce	tb	R	f	n	1 2 3 4 7	8	b	0					40.4	79
ce	tb	R	n	f	5 6 #		b	0					17.3	234
ce	tb	l	f	n	2 3	7	b	0					6.3	96
ce	tb	l	f	n		3 7	c	0					6	86

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	tb	r	f	n	1 2 3 4	7	b	0					26	53
ce	tb	l	n	f	5 6	#	b	0					13	50
ce	tb	l	n	f	5 6	#	b	0					17	53
ce	tb	l	n	n		8 9	b	0					21.2	363
ce	tb	l	n	n		7	b	0					8.3	276
ce	tb	l	n	n		7 8	b	0					13.7	39.1
ce	tb	r	n	n		7	b	0					2.1	98
ce	tb	r	n	f	5 6 9 #		b	0					68.1	112
ce	tb	L	n	f	5 6	#	b	0		11 fm, 2 cm	#		18.3	121
ce	tb	L	n	f	5 6	#	b	0					9.3	20
ce	tb	r	f	n	4	7 8	a	0					20.1	843
ce	tb	r	f	n	3	7	b	0					6.9	355
ce	tb	L	n	n		7 8	b	0					16.3	514
ce	ul	L	n	-	D	C E	b	0		-		-	3.8	39
ce	ul	L	n	-	C	B E	b	0		-		-	12.2	56
ce	ul	L	f	-	A B		b	0		-		-	6.8	285
ce	ul	L	f	-	A B		b	0		-		-	8.5	363
ce	ul	R	n	n	E F G	-	a	0		-		-	6	188
ce	ul	L	u	-	B C D		c	0		-		-	4.6	53
ce	ul	R	f	-	A B C D		b	0		2 fm	B		13.6	129
ce	ul	R	n	-	C D	B E	c	0		-		-	7.3	98
ce	ul	R	fu	-	A	B	b	0		-		-	3.4	35
ce	ul	R	n	-	C D E		b	0		-		-	6.7	200

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ce	ul	R	f	-	A B C D		b	0		-		-	13	101
ce	ul	L	n	n	F	E G	b	0		-		-	2.3	101
ce?	dph	r			1	2	b	-	-	-	-	-	2	53
ce?	fe	R	n	u		7 8	b	0					5.9	101
ce?	hu	L	u	n	# @	9	b	0					25.2	38
ce?	hu	R	n	n	9		b	0		9 fm	9		8.5	685
ce?	hu	L	n	n	9		b	0					7.8	61
ce?	mt	L	f	n		1 5	b	0					1.6	443
ce?	mt	L	f	n		1 5	b	0					14.4	173
ce?	ra	L	n	n		8 9	b	0		-		-	14.9	188
ce?	ra	R	n	n		5 6 7 8	c	0		-		-	10.2	200
ce?	ra	L	n	n	6 7	8	b	0		-		-	18.5	99
ce?	ra	R	n	n	-	6	a	0		-		-	11.2	188
ce?	ra	L	n	n	-	6 8	b	0		-		neonatal	7.4	99
ce?	sc	R	u	u	2 3 5	7 9	b	0					2.2	201
ce?	tb	R	u	n		7	b	0					5.7	37
ce?	tb	R	n	n		7 8	b	0	gn	7 fm	7 8		6.9	328
ce?	ul	R	n	n	-	G	c	0		-		-	0.8	101
cf?	fe	L	n	n	# @		b	0					0.9	365
cf?	fe	L	u	n	4		a	0					0.3	363
ch	ra	L	n	u	3 4		a	0				-	2	388
ec	ast	L			1 2 3 4		b	0		10 dm, 2 dm	1, 2		76.6	221
ec	ast	R			1 2 3 4		b	0		3 ? dm, 2 dm	1, 2		45.3	199

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ec	ast	r	-	-	1 2 3 4		c	0					42	876
ec	at	-			1 2		b	0					84.2	315
ec	cal	l	f	-	1 2 3 4 5		b	0		6 km	2		48.5	315
ec	cal	L	u		2 3 4 5		b	0		1 km	2		33.4	199
ec	dph	-	f		1 2		b	0					22.1	315
ec	dph	-	f		1 2		b	0					6.4	88
ec	dph	-	f		1 2		b	0					18.3	173
ec	ep	-		n	4	1	c	0		3 cm	4		40.8	173
ec	ep	-		n		1 4	b	0		2 cm 1			42.5	315
ec	fe	L	n	f	9 # @	7 8	a	0					142.4	173
ec	fe	L	f	n	1	3	a	0				nbr	35	173
ec	fe	L	n	n	3	5	b	0				nbr	30.4	173
ec	fe	L	f	n	4		a	0				nbr	28.2	173
ec	fe	r	f	n	4	5	b	0					41.5284	53
ec	mc	l	f	n		1 2 3	b	0					30.2	315
ec	mc	r	n	f	2	3	b	0					22.7	288
ec	mc II -III	R	n	f	3 4	7 8	b	0					20.9	135
ec	mc II -III	L	f	n	1	6	b	0	gn				22.2	135
ec	mc II -III	R	n	f	3 4	7 8	b	0					17.8	79
ec	mc IV	R	f	n	p half		b	0					10.4	200
ec	mc IV	r	f	-	1 3		b	0					5.3	288
ec	mc IV	L	f	n	p half		b	0	gn?			218b	8.6	218
ec	mc IV	L	f	n	p half		b	0					9.5	221

Species	Element	Side	Prox	Dist	Frag(>50%)	Frag(<50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ec	mc IV	L	f	n	p half		b	0					4.8	135
ec	mph	-	f	f	1 2 3		c	0					15.4	53
ec	mph	-	f		1 2 3		b	0					23	61
ec	mph	-	f		1 2 3		b	0					16.4	173
ec	mt II - III	R	n	f	3 4	7 8	b	0					28.6	672
ec	mt II - III	R	f	n	1 2 5 6		b	0				? workedtapers i	64.9	200
ec	mt II - III	L	f	n	1 2 5 6		c	0				? worked, "sharp	68.3	390
ec	mt II - III	L	n	f	3 4	7 8	b	0					33.1	61
ec	pe	L	f		1 2 3 4 5 6 8	11	b	0		2 cm	6&11, 8		121.6	173
ec	pph	-	n	f		2 3	c	0					5.9	530
ec	pph	-	f	n	1	3	c	0					12.5	315
ec	pph	R	f		1 2 3		b	0		7 km	3		32	173
ec	pph	-	n		2	3	b	0					5.3	200
ec	pph	-	f			1 2 3	b	0					9.2	173
ec	pph	R	f		1 3		b	0		7 km	3		16.2	288
ec	pph	R	n			2 3	b	0		15 - 20km	3		5.9	288
ec	pph	R	f		1 2 3		b	0		20 km	3		47.5	221
ec	ra	R	n	u	J 3 4	-	a	0		-		-	26.8	88
ec	ra	R	f	n	-	1 5	b	0		-		-	11	280
ec	ra	R	f	n	-	1	b	0		-		-	8.7	138
ec	ra	L	n	u	J	3	a	0		-		-	13.2	88
ec	ra	R	f	n	1	2 5	b	0		-		-	32.3	173
ec	ra	l	f	n		2 5	b	0		4 dm, 8 kn	2, 5		24.6	315

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ec	ra	L	n	u	9 #	8	b	0		-		-	18.9	98
ec	ra	L	f	n	1	5	b	0		-		-	13.1	221
ec	sc	R	f	f	1 2 3 4 5	6 7	b	0					99.8	221
ec	sc	L	f	f	1 2 3 4 5 6 7 8 9		b	0					179.6	173
ec	sc	L	f	f	1 2 3	4 5	b	0					38	264
ec	tb	r	n	f	5 6	#	c	0					44.2	315
ec	tb	l	n	f	5 6		b	0					24.6	53
ec	tb	R	f	n	1	7	b	0					28.1	135
ec	ul	R	n	-	-	C	c	0		-		-	10.6	173
hg	fb	l	u	u	(complete)		b	0				neonatal	4.3	127
hg	fe	l	u	u	2 3 5 6 7 8		b	0				neonatal	6.7	363
hg	pe	l	u		2 6 @	4	b	0				neonatal	3.8	364
hg	pe	l	u		3 8 9	@	b	0				neonatal	3.8	364
hg	pe	r	u		2 6 @	4	b	0				neonatal	3.4	378
hg	pe	l	u		1 5 7 #	4	b	0				neonatal	5.3	364
hg	ra	l	u	u	5 6 7 8 9 #		b	0					9.3	364
hg	sc	l	u		4 5 6 7 8 9		b	0				neonatal	5	363
hg/pv	sc	r	u		4 5 6 7 8 9		b	0		1 fm	5		9.5	363
hp/pv	ax	-			1 2		b	0		1 cm	1 (ant face)	juv	9.2	658
lgm	fe	R	n	u	9 # @		c	0				neo	8.1	653
lgm	fe	R	n	n		7	b	0					7	63
lgm	fe	R	n	u		7 8	c	0					5.1	620
lgm	fe	L	n	n		7	b	0					8.5	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgm	fe	-	n	n		7	c	0					2.9	512
lgm	fe	R	-	u	9 # @		b	0				neo	5.3	112
lgm	fe	-	u	n	4	-	d	0					9.3	63
lgm	fe	R	n	u	9 # @		c	0				neo	7.6	363
lgm	fe	L	n	u	9 # @		c	0				neo	7.6	1000
lgm	fe	L	n	u	9 # @		d	0				neo	5.6	56
lgm	fe	L	n	u	9 # @		c	0				neo	7.6	384
lgm	fe	L	n	u	9 # @		c	0				neo	6.6	402
lgm	fe	L	n	n	2	3 6	b	0					29.1	603
lgm	fe	R	n	n		2	b	0					7.3	122
lgm	fe	-	n	n		7	b	0					8.2	120
lgm	fe	R	-	u	9 # @		d	0				neo	3.6	11
lgm	hu	L	u	u		7	b	0					14.4	626
lgm	hu	R	n	n		5	b	0					0.8	603
lgm	hu	R	n	f	5		c	0					5.8	514
lgm	hu	L	u	u		7 8	b	0					13	653
lgm	hu	L	u	n	2		b	0					4	56
lgm	hu	L	n	n		6	c	0					2.7	514
lgm	pe	R	u		2	6	b	0					2	112
lgm	pe	L	u		2 6	4 @	b	0					9.2	620
lgm	pe	L	u	u	3 8		b	0					1.9	61
lgm	pe	R	u		2 6	@	b	0					8.3	56
lgm	pe	R	u		2 6 @		b	0					4.5	620

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgm	pe	R	u		2 6		b	0					3.8	397
lgm	pe	L	n	n	1	5	b	0					6	199
lgm	pe	R	u		2 6 @		b	0					5.3	425
lgm	ra	R	n	u	8 9 #	6 7	c	0		2 cm	6	-	5.8	522
lgm	ra	R	n	n	5 6 7 8	9 #	b	0		-		-	14.8	87
lgm	ra	R	n	n	-	6 7	c	0		-		-	9.4	443
lgm	ra	L	n	n	6 7 8	5 9 #	d	0	gn	-		-	21.7	612
lgm	ra	L	u	n		2 5	b	0					1.2	285
lgm	ra	L	u	n		5 6 7	b	0					12.3	173
lgm	sc	R	f	n	2 3 4 5	6	b	0	gn				5.5	56
lgm	tb	L	u	n	1		b	0					2.2	603
lgm	tb	R	u	n	1 2 3		c	0				neonatal	4.2	188
lgm	tb	L	fu	n		4 7	b	0					2.6	34
lgm	tb	L	n	n		7	b	0					8.2	61
lgm	tb	L	f	n	3	7	b	0					1.9	9
lgm	tb	L	n	n		7 8	b	0					2.2	378
lgm	tb	L	u	n		2	b	0				neonatal	0.9	101
lgm	tb	L	n	u		9 #	b	0					9.9	436
lgm	tb	L	n	n		7 8 9	b	0					5.5	129
lgm	tb	L	u	n		7	c	0					8.1	52
lgm	tb	R	u	n	3	2 4	b	0					2.5	364
lgm	tb	R	f	n		1 7	b	0					6.4	37
lgm	tb	L	u	n		7 8	b	0					6.6	173

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgm	tb	R	n	n		7	b	0					7.4	188
lgm	tb	R	n	n		7	b	0					8.5	98
lgm	tb	L	n	n		7	b	0					3.2	365
lgm	tb	R	n	n		7	b	0					8.4	98
lgm	tb	L	u	n		7	b	0					1.3	333
lgm	tb	l	u	n		7	b	0					6.9	112
lgm	tb	R	n	u	5 6		b	0					2	188
lgm	tb	R	n	u	5	6	b	0					1	472
lgm	tb	R	n	n		7 8	b	0					13.5	149
lgm	tb	L	n	u	5 6		b	0					1.2	378
lgm	tb	L	n	n		7 8	b	0					19.3	101
lgm	tb	l	n	n		8	b	0					16.7	250
lgm	ul	R	n	n	F G	-	b	0		-		-	3.1	39
lgm	ul	L	n	n	-	F G	a	0		-		-	0.9	466
lgm	ul	R	n	n	-	C	b	0		-		-	1.7	98
lgm	ul	L	n	n	D	C F	b	0		-		Neonatal	1.9	1000
lgm	ul	L	n	n	B	C	d	0		3 km	3	Neonatal	1.6	1000
lgm	ul	R	n	-	D E	C F	d	0		-		-	21.2	603
lgr	ast	l	-	-	1 2 3	4	c	0				neonatal	4.5	53
lgr	ast	L			1 2 3 4		d	0				neonat	2	355
lgr	ast	L			1 2 3 4		c	0				neonat	2.4	425
lgr	cal	L	u		2 3	4	b	0		1 cm	2		3.8	398
lgr	cal	L	f			1 2	b	0					3.8	35

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgr	cal	L	u		2	3	b	0					1.8	529
lgr	cal	L	u		2 3	4	b	0					5.2	61
lgr	cal	L	u		2 3 4 5		b	0					6.5	221
lgr	cal	L	u		2 3 4 5		b	0					4.5	288
lgr	dph	R	f		1 2		b	0				neonate	1.6	466
lgr	dph	r	-		2	1	b	3	-	-	-	char	3.2	863
lgr	dph	r	-			2	b	4	-	-	-	cal	0.8	863
lgr	dph	l	-			2	b	4	-	-	-	char	1	863
lgr	dph	R	f		1 2		b	0				neonate	1	620
lgr	dph	R	f		1 2		b	0					1.1	388
lgr	dph	R	f		1 2		b	0					0.9	363
lgr	dph	L	f		2		b	0					1.8	365
lgr	fe	l	u	n	9 # @		d	0				neonatal	2.7	454
lgr	fe	L	u	u	2 3 5 6 7 8		b	0					22.2	615
lgr	fe	R	n	n		7 8	b	0	gn				9.9	56
lgr	fe	L	f	n	1 4 5	3	b	0					22.9	188
lgr	fe	L	u	u	2 3 5 6 7 8		b	0					19.6	63
lgr	fe	L	u	u	2 3 5 6 7 8		b	0					22.4	120
lgr	fe	L	u	n	2 3 5 6 7 8		b	0					17	122
lgr	fe	L	u	n	2 3 5		b	0					5.7	101
lgr	fe	R	u	n	2 3 5		b	0					10.8	355
lgr	fe	R	n	n	7	8	b	0					16.8	37
lgr	fe	L	n	n		10	b	0					6.5	39

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgr	fe	L	n	n		# @	b	0					9.5	54
lgr	fe	R	u	n	4		b	0					3	199
lgr	fe	L	n	n		2 5 6	b	0					11.1	123
lgr	fe	L	n	n	#		b	0					18.2	390
lgr	hu	R	n	u	4 6		b	0					2.3	423
lgr	hu	R	n	u		7 8	b	0					4.5	496
lgr	hu	l	u			@	b	0					2.5	173
lgr	hu	R	n	n		7 8	c	0					4.2	56
lgr	hu	L	n	u	5 6		b	0					3	57
lgr	hu	R	n	u	5 6		b	1					2.6	496
lgr	hu	L	u	u	7 8 9 # @		b	0					18.7	276
lgr	hu	R	n	n	7 8 9 # @		b	0				neo	15.5	79
lgr	hu	R	u	u	7 8 9 # @		b	0					17.2	138
lgr	hu	L	n	u		7 8	b	0					8.3	97
lgr	hu	L	n	u	8	7	b	0					8.7	628
lgr	hu	R	n	f	5	6	c	0					13.2	37
lgr	mc	R	n	u		7 8	b	0					4.3	425
lgr	mc	-	n	n		7 8	b	0					3.5	26
lgr	mc	L	u	n	6		b	0					3.1	205
lgr	mc	-	n	n		?	b	0					3.7	98
lgr	mc	R	u	n	2	6	b	0					0.9	205
lgr	mc	l	f	n		2 5	b	0					2.3	288
lgr	mp	-	n	n		$	b	4				burnt	2.6	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgr	mp	-	n	f		£ $	b	0					3.6	402
lgr	mp	-	n	n		$	b	0					2.2	315
lgr	mp	-	n	n		$	b	0					0.9	274
lgr	mp	-	n	u	$		c	0					2.1	20
lgr	mp	-	n	n		$	c	0				burnt	1.6	863
lgr	mp	-	n	f	$		b	0		3 dm	$0		2.9	234
lgr	mp	-	n	n		5 6 7 8	b	0					2.9	101
lgr	mp	-	n	n		$	c	0					1.2	112
lgr	mp	-	n	n		5 6 7 8	b	0					8.3	79
lgr	mp	-	n	n		$	c	0				burnt	1.1	863
lgr	mp	-	n	n		5 6 7 8	b	0					5.7	98
lgr	mp	-	n	n		5 6 7 8	b	0					2.6	281
lgr	mp	-	n	f		$ £	b	0					5.1	378
lgr	mph	l	u		1		b	-	-	-	-	-	0.3	650
lgr	mt	L	n	n	5 6 7 8		b	0					4.8	378
lgr	mt	L	n	n	5 6 7 8		b	0					10.1	378
lgr	mt	L	n	n	5 6 7 8		b	0					7.6	56
lgr	mt	L	u	n		5 6	b	0					2.9	
lgr	mt	-	n	u	£		b	0					2.5	355
lgr	mt	R	n	u	7 8		b	0					7.3	624
lgr	mt	L	n	n	5 6 7 8		b	0					9.4	539
lgr	pe	R	n	n	3	8	b	0					7.7	56
lgr	pe	R	n	n	3 8		c	0					6.6	53

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgr	pe	L	n	n	3 8		b	0		cm	8	nb	4.6	56
lgr	pe	r	u	-	1	5	d	0					1.7	112
lgr	pe	r	u	-	2 4 6		b	0				neonat	5.7	173
lgr	pe	r	u	-	2	6	c	0		1 km, 1 km	2, 6		2.9	112
lgr	pe	r	u	-	3 8		c	0		1 dm	8		3.3	112
lgr	pe	L	u		1 5 #	7	b	0					5.9	653
lgr	pph	r	u	n	1		b	0				neonat	0.7	454
lgr	pph	L	n		2	3	b	0					0.7	251
lgr	pph	r	u	n	1		b	0				neonat	0.4	248
lgr	pph	r	u	n	1		b	0				neonat	0.7	285
lgr	pph	r	u	n	1		b	0				neonat	1.1	441
lgr	pph	R	u		2 3		b	0					2.1	98
lgr	pph	L	f		1	2	b	0					1.5	101
lgr	pph	L	n			2 3	b	0					1	398
lgr	pph	L	u		2 3		b	0					1.5	26
lgr	pph	l	f	n		1	b	0					0.3	53
lgr	pph	R	u		2 3		b	0					2	328
lgr	pph	R	u		2 3		b	0					2.6	221
lgr	pph	R	u		2 3		b	0					1.7	284
lgr	pph	R	u		1		b	0					1.9	188
lgr	pph	R	u		1		b	0					0.6	378
lgr	pph	R	u		1		b	0					0.5	101
lgr	pph	L	u		1		b	0					0.6	26

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
lgr	pph	R	f		1	3	b	0					1.6	603
lgr	pph	L	u		2 3		b	0					1.5	227
lgr	pph	R	u		1		b	0					0.6	328
lgr	pph	L	u		2 3		b	0					1.2	603
lgr	pph	R	u		2 3		b	0					2	88
lgr	pph	R	u		2 3		b	0					1.9	364
lgr	pph	R	f			1 3	b	0					1.8	123
lgr	ra	R	n	n	6 7 8 9	5 #	b	0				young	6.4	365
lgr	ra	L	n	u	6 7 8 9 #	5	b	0				young	10.4	285
lgr	ra	R	u	u	5 6 7 8 9 #		b	0					7.1	402
lgr	tb	L	f	n		4 7 8	b	0					46.5	603
lgr	tb	r	u	u	7 8 9 #		b	0		1 fm	7		21	53
lgr	tb	l	n	u	5 6		b	0					1.3	98
lgr	tb	r	u	n		7	b	0					8.6	112
lgr	tb	r	n	n		8	b	0					19.2	112
lgr	tb	R	f	n		4 7	b	0					16.7	54
lgr	tb	r	n	n		9 #	a	0					32.9	884
ll	cal	l	f		1 2 3 4 5		b	0					1.7	363
ll	cal	l	u		2 3 4 5		b	0					1	365
ll	fe	l	n	u	9 # @		b	0					1.1	365
ll	fe	l	u	u	2 3 6 7 8		b	0					3.7	365
ll	fe	l	f	f	1 2 3 4 5 6 7 8 9 # @		b	0					4.9	363
ll	fe	r	n	u	9	# @	b	0					1.4	365

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ll	fe	r	f	f	1 2 3 4 5 6 7 8 9 #	@	c	0					7.5	512
ll	fe	r	f	f	1 2 3 4 5 6 7 8 9 # @		b	0		2 fm	8, 7-8		9.1	365
ll	fe	l	u	u	2 3 6 7 8		b	0		2 fm	6, 7-8		4.5	122
ll	hu	l	f	f	1 2 3 4 5 6 7 8 9 # @		b	0		11 fm	7		6	378
ll	hu	l	f	f	1 2 3 4 5 6 7 8 9 # @		b	0					6.1	97
ll	hu	l	f	f	1 2 3 4 5 6 7 8 9 # @		b	0					5.3	149
ll	hu	r	f	f	1 2 3 4 5 6 7 8 9 # @		b	0		1	fm	9	6.7	87
ll	hu	r	f	f	1 2 3 4 5 6 7 8 9 # @		b	0					4.8	620
ll	mp	-	f	f	1 2 3		b	0					0.3	129
ll	mp	-	f	f	1 2 3		b	0					0.5	363
ll	mp	-	f	f	1 2 3		b	0					0.9	365
ll	mp	-	f	f	1 2 3		b	0					0.6	53
ll	pe	l	f		1 2 3 4 5 6 7 # @	8	c	0					4.3	512
ll	pe	l	f		1 2 3 4 5 6 7 8 # @		b	0					3.5	365
ll	pe	r	f		1 2 3 4 5 6 7 # @	8	b	0					4.7	363
ll	sc	l	f		1 2 3 4 5 6 7 8 9		b	0	0				2.9	365
ll	tb	l	n	f	5 6 7 8 9 #		b	0					4.6	676
ll	tb	l	u	u	7 8 9 #		b	0					2.7	365
ll	tb	r	u	u	7 8 9 #		b	0					3.9	662
ll	tb	l	n	n	7 8 9 #		b	0				young	2.8	288
ll	tb	r	n	u	5 6		b	0					0.3	365
ll	ul	l	f		A B C D E F G H J		b	0					2.4	378
ll	ul	r	f		A B C D E F G H		b	0					4.5	885

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
mdm	fe	L	n	u		7 8	b	0					3 1	603
mdm	fe	R	u	n	2 3 5		b	0					1	620
mdm	fe	R	n	n		@	b	0					1.6	612
mdm	fe	-	u	n	4		c	0					0.6	439
mdm	fe	R	n	u		7 8	c	0					3.2	466
mdm	fe	L	n	u	9 # @		c	0				neo	1.1	209
mdm	hu	R	n	n		4	b	0					2.2	365
mdm	hu	L	u	n	2		b	0					1.3	378
mdm	pe	R	n		1 5		b	0					2.4	512
mdm	pe	L	u	n	3 8		b	0					0.6	209
mdm	pe	L	u		2 6	4 @	b	0					2.8	120
mdm	pe	L	u		2 6	4 @	b	0					0.5	227
mdm	pe	L	u		1 5	7 #	b	0					0.7	227
mdm	ra	L	n	u	3 4	-	c	0		-		-	2.8	496
mdm	ra	L	n	n	6 7	8	c	0		-		-	6.7	79
mdm	ra	L	n	u	-	8 9 #	b	0		-		-	5.1	188
mdm	sc	L	u	u	1 2 3 4 5		c	0		spine removed	4		2.4	615
mdm	ul	R	n	n	-	E	a	0		-		-	1.2	98
mdm	ul	R	n	n	-	F	b	0		-		-	0.5	97
oa	ast	l	-	-	1 2 3 4		c	0					1.8	112
oa	ast	R			1 2 3 4		b	0		1dm, 1dm	1, 2		2.7	120
oa	ast	L			1 2 3 4		c	0					4.4	129
oa	ast	L			1 2 3 4		c	0					2.1	378

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	ast	L			1 2 3 4		b	0					1.5	388
oa	ast	L			1 2 3 4		b	0		1 dm	4		2.4	363
oa	ast	L			1 2 3 4		c	0		2dm	1		1.5	1000
oa	ast	R			1 2 3 4		b	0		2 dm, 1 dm	3, 4		3.5	363
oa	ast	r	-	-	1 2 3 4		c	0					3.6	379
oa	ast	R			1 2 3 4		b	0					3.8	100
oa	ast	r	-	-	1 2 3 4		c	0					3.3	53
oa	ast	R			1 2 3 4		b	0					2.7	397
oa	ast	R			1 2 3 4		a	0					3.6	364
oa	ast	R			1 2 3 4		b	0					2.8	1001
oa	ast	R			1 2 3 4		b	0		1dm, 2dm	2, 4		2.1	112
oa	ast	R			1 2 3 4		b	0					3.2	98
oa	ast	l	-	-	1 2 3 4		c	1				burnt	1.7	112
oa	ast	R			1 2 3 4		b	0		3dm	3		3.7	315
oa	at	-			1 2		b	0		1 cm, 1 cm	1, 2		4.5	112
oa	at	-			1 2		b	0					10.5	58
oa	cal	r	u	-	2 3 4 5		c	0					2.9	441
oa	cal	l	u	-	2 3 4 5		b	0					5	148
oa	cal	l	u	-	2 3 4 5		b	0					1.9	112
oa	cal	l	u	-	2 3 4 5		c	0					2	112
oa	cal	l	f	-	1 2 3 4 5		b	0					4.4	148
oa	cal	r	u	-	3 4 5	2	b	0					1.1	112
oa	cal	L	f		1 2 3 4 5		b	0		2 ?dm			3.8	284

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	cal	r	u	-	2 3 4 5		b	0					1.3	112
oa	cal	r	u	-	2 3 4 5		c	0					1.9	112
oa	cal	r	u	-	2 3 4 5		b	0					3.7	315
oa	cal	R	f		1 2 3 4 5		b	0					4.1	38
oa	cal	L	u		2 3 4 5		b	0					2.6	130
oa	cal	R	f		1 2 3 4 5		b	0					4.2	620
oa	cal	L	u		2 3 4 5		b	0					2.1	378
oa	cal	R	f		1 2 3 4 5		b	0					3.8	388
oa	cal	R	u		2 3 4 5		b	0		2dm	2		2.5	199
oa	cal	R	n		2 3 4 5		b	0					1.9	378
oa	cal	R	u		2 3 4 5		b	0					4.5	53
oa	cal	R	f		1 2 3 4 5		b	0					3.3	101
oa	dph	L	f		1 2		b	0					0.5	472
oa	dph	R	f		1 2		b	0					0.4	160
oa	dph	R	f		1 2		b	0					0.3	160
oa	dph	L	f		1 2		b	0					1.2	1001
oa	dph	L	f		1 2		b	0					0.7	101
oa	dph	L	f		1 2		b	0					0.6	98
oa	dph	L	f		1 2		b	0					0.7	653
oa	dph	L	f		1 2		b	0					0.9	160
oa	dph	R	f		1 2		b	0					0.6	653
oa	fe	r	u	n	4		b	0	gn				0.5	112
oa	fe	L	n	f	9 # @	7 8	c	0					6.2	620

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	fe	R	n	f	9 # @	7 8	b	0					6.9	363
oa	fe	r	f	n	4	5	b	0					3.3	123
oa	fe	L	n	f	9 # @	7 8	b	0					9.5	276
oa	fe	R	n	f	9 # @	7 8	b	0					14.6	435
oa	fe	l	n	fu	# @	7 8 9	c	0					4.6	873
oa	fe	L	n	f	9 # @	7 8	b	0					10.5	188
oa	fe	r	u	n	1		d	0					0.5	112
oa	fe	L	f	n	1 4 5	2 3	b	0					7.1	227
oa	fe	L	n	u	9 # @		c	0					6.9	78
oa	fe	L	n	u	9 # @		b	0					5.3	205
oa	fe	l	n	f	9 # @	7 8	c	0					10.6	689
oa	hu	L	n	f	3 4 5 6 7 8 9 #	@	b	0					7.2	423
oa	hu	L	n	f	3 4 5 6	7 8	b	0					6.8	120
oa	hu	L	n	f	7 8	5 6	b	0					6.2	653
oa	hu	L	n	f	7 8	5	b	0					2.9	620
oa	hu	L	n	f	3 4 5 6	7 8	b	0		3 dm	caud 8		7.1	200
oa	hu	L	n	fu	3 4 5 6	7 8	b	0					3.6	164
oa	hu	L	n	fu	3 4 5 6 7 8		b	0					6	101
oa	hu	L	n	f	3 4 5 6	7 8	b	0					8.2	378
oa	hu	R	n	f	3 4 5 6 7	8	c	0					8	378
oa	hu	L	n	f	3 4 5 6	7 8	b	0					5.4	26
oa	hu	L	n	fu	3 4 5 6 7 8	9 #	b	0					6.6	205
oa	hu	R	n	fu	3 4 5 6 7 8		b	0					3.5	397

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	hu	R	u	f	3 4 5 6	7	c	0		6 ? Km	7		4.8	853
oa	hu	R	n	f	3 4 5 6	7 8	b	0					5.1	221
oa	hu	R	n	f	3 4 5 6	7 8	b	0					7.3	199
oa	hu	R	n	f	3 4 5 6 7	8	b	0					5.7	436
oa	hu	R	n	f	3 4 5 6 8	7	b	0		2 fm	8		8.3	365
oa	hu	L	n	f	3 4 5 6 7 8 9 # @		b	0		4 fm	mde & ant		13.5	1000
oa	hu	R	n	fu	3 4 5 6	7 8	b	0					5.8	328
oa	hu	R	n	f	3 4 5 6 7 8	9 #	b	0					8.3	226
oa	hu	R	n	f	3 4 5 6 7 8 9 #	@	b	0		7 fm, 2 fm,	cran 8, cau		11.9	466
oa	hu	R	n	f	1 2 3 4 5 6 7 8 9 # @		b	0					19	88
oa	hu	L	u	fu	3 4 5 6 7 8 9 # @		b	0		6 fm	med 8		11.6	148
oa	hu	R	n	f	3 4 5 6	7 8	c	0					3.6	26
oa	hu	R	n	f	3 4 5 6	7 8	c	0					11.4	26
oa	mc	R	n	f	3 4	7 8	b	0					2.6	432
oa	mc	R	f	n	1 2 5 6 7 8		c	0					14.4	53
oa	mc	R	n	f	3 4 7 8		b	0					5.7	288
oa	mc	R	f	n	1 2 5 6	8	b	0					10.4	276
oa	mc	l	n	u	3 4		b	0					1.1	112
oa	mc	R	f	n	1 2 5 6 7		b	0		4 fm	6		6.4	653
oa	mc	l	n	u	3 4		b	0		1 dm	3		2	148
oa	mc	R	n	f	3 4	7 8	b	0					3.5	129
oa	mc	L	f	u	1 2 5 6	7 8	c	0					6.9	378
oa	mc	r	n	f	3 4 7 8		c	0		12 fm, 6 fm	7, 8		3.6	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	mc	L	f	u	1 2 5 6 7 8		b	0		> 20 fm	5/6		11.8	626
oa	mc	l	n	f	3 4	7 8	c	4		1 dm	8	burnt	2.7	261
oa	mc	L	f	n	1 2	5 6	b	0					3	96
oa	mc	L	n	fu	3 4	7 8	b	0					3.3	227
oa	mc	L	f	u	1 2 5	6 7	b	0					5	653
oa	mph	L	f		1 2 3		b	0					0.7	620
oa	mph	L	f		1 2 3		b	0					0.8	603
oa	mph	L	f		1 2 3		b	0					0.8	378
oa	mph	L	u		2 3		b	0					0.6	472
oa	mph	L	f		1 2 3		b	0					1	209
oa	mph	L	f		1	3	b	0					0.4	378
oa	mph	L	f		1 2 3		b	0					0.9	160
oa	mph	L	fu		1 2 3		b	0		1 km	1		1	101
oa	mph	L	f		1 2 3		b	0					0.8	120
oa	mph	L	f		1 2 3		b	0					0.6	378
oa	mph	L	fu		1 2 3		b	0					0.5	160
oa	mph	L	fu		1 2 3		b	0					0.6	160
oa	mph	L	fu		1 2 3		c	0					0.6	36
oa	mph	L	f		1 2 3		b	0		1 ?km	3		0.6	620
oa	mph	R	f		1 2 3		b	0					0.5	160
oa	mph	R	f		1 2 3		b	0					0.9	379
oa	mph	L	f		1 2 3		b	0					0.9	621
oa	mph	L	f		1 2 3		b	0					0.5	209

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	mph	R	fu		1 2 3		b	0					0.5	620
oa	mph	R	fu		1 2 3		c	0					0.6	512
oa	mt	R	f	n		1 2 5 6	b	0					2.1	365
oa	mt	L	n	f	3 4 7 8		b	0		5 fm, 5 sm	7, 7/8		5.6	130
oa	mt	R	n	f	3 4 7 8	5 6	c	0					12.6	83
oa	mt	l	n	f	3 4 7 8		c	0					5.6	64
oa	mt	r	f	f	1 2 3 4 5 6 7 8		b	0					18.9	831
oa	mt	L	n	f	3 4 7	8	b	0		2 fm, 1 fm	7, 8		3.6	199
oa	mt	r	n	u	3 4		a	0		3 dm	4		2.8	876
oa	mt	L	f	f	1 2 3 4 5 6 7 8		b	0					12.1	173
oa	mt	R	f	u	1 2 5 6 7 8		c	0		fm	5		14.4	676
oa	pe	l	f		1 5	4	b	0					7.6	64
oa	pph	R	f		1 2 3		b	0					1.5	388
oa	pph	R	f		1 2 3		b	0					1.7	101
oa	pph	R	f		1 2 3		a	0					2.4	653
oa	pph	L	f		1 2 3		b	0					1.8	620
oa	pph	R	fu		1 2 3		b	0					1.3	160
oa	pph	L	f		1 2 3		b	0					2.1	378
oa	pph	R	fu		1 2 3		b	0					1.4	512
oa	pph	L	f		1 2 3		b	0		? fm	3		1.6	188
oa	pph	R	f		1 2 3		b	0					1.5	426
oa	pph	R	f		1 2 3		b	0					1.8	56
oa	pph	R	fu		1 2 3		b	0					1.2	160

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	pph	R	u		2 3		c	0					1.4	472
oa	pph	L	fu		1 2 3		b	0					1.2	160
oa	pph	R	f		1 2 3		b	0		2fm	3		1	209
oa	pph	L	f		1 2 3		b	0	?gn				2.6	98
oa	pph	R	f		1 2 3		b	0					2.2	200
oa	pph	R	u		1		b	0					0.5	472
oa	pph	R	u		2 3		b	0					1.8	101
oa	pph	L	u		2 3		b	0					0.7	398
oa	pph	L	fu		1 2 3		b	0					1.9	402
oa	pph	L	fu		1 2 3		b	0		2fm	3		1.4	160
oa	pph	L	fu		1 2 3		b	0					3.2	164
oa	pph	L	f		1 2 3		b	0					2.6	160
oa	pph	R	f		1 2 3		b	0		fm	3		2	160
oa	pph	L	u		1		c	0					0.2	26
oa	pph	R	f		1 2 3		b	0					1.7	98
oa	pph	L	f		1 2 3		b	0		2 ?fm	3		1.6	227
oa	pph	R	u		2 3		b	0					1.2	522
oa	pph	R	f		1 2 3		b	0					1.8	603
oa	ra	L	f	n		2 5 7	c	1					1.5	280
oa	ra	L	f	n	1 2	5	a	0				-	3	427
oa	ra	R	n	f	3 4 J	9 #	b	0					5	364
oa	ra	R	f	n	1 2 5 6 7	8	b	0		3 dm	5 med		5.9	234
oa	ra	L	n	u	3 4		a	0				-	1	603

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	ra	R	f	u	1 2 5 6 7 8 9 #	-	b	2		-		-	13.3	173
oa	ra	L	n	u	8 9 #		a	0				-	3.3	603
oa	ra	R	f	n	1 2 5 6 7	8	b	0		-		-	3.8	423
oa	ra	L	f	u	1 2 5 6 7 8 9 #	-	b	0		fm	7	-	6.8	184
oa	ra	R	n	u	3 4		b	0					1.8	164
oa	ra	R	f	n	1 2 5 6 7	8	b	0					5.7	398
oa	ra	L	n	u	3 4		a	0				-	1.2	653
oa	ra	R	f	u	1 2 5 6 7 8 9 #	-	b	0				-	14.1	425
oa	ra	L	f	n	1 2 5 6 7 8	9 #	b	0				-	12.4	37
oa	ra	L	n	u	3 4		a	0				-	0.8	852
oa	ra	L	f	n	1 2 5 6 7		b	0				-	5.1	86
oa	ra	L	f	n	1 2 5		a	0				-	6.8	425
oa	ra	L	f	f	1 2 3 4 5 6 7 8 9 # J	-	b	0	gn	sfm	5	-	15.7	188
oa	ra	L	f	n	1 2	5 7	b	0		9 fm	5 dors	-	3.4	149
oa	ra	R	-	f	3 4		a	0				-	2	425
oa	ra	L	f	u	1 2 5 6 7 8 9 #	-	c	0		-		-	13	112
oa	ra	L	-	u	3 4		a	0				-	1.6	462
oa	ra	R	f	n	1 2 5 6 7 8	9 #	b	0	rd	fm	dors 6	-	14	83
oa	sc	R	f	f	1 2 3 4 5	6	b	0					5.2	388
oa	sc	R	f	f	1 2 3 4 5 6 7 8 9		b	0					11.6	129
oa	sc	R	f	f	1 2 3 4 5	6 7	b	0					3.1	378
oa	sc	R	f	n	2 3 4 5	6 7	c	0					2.4	201
oa	sc	R	f	f	1 2 3	4 5	b	0					2.3	105

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
oa	sc	L	f	f	1 2 3 4 5 6 7	8 9	b	0					12.4	201
oa	sc	L	f	f	1 2 3 4 5	6 7	b	0					7.6	388
oa	sc	L	f	f	1 2 3 4 5	6 7 9	b	0					8.3	365
oa	sc	L	f	f	1 2 3 4 5 6	7	b	0					6.4	378
oa	sc	L	f	n	1 2 3 4 5	7	b	0		dm, 7 km	2, 2&3		3.6	173
oa	sc	R	f	f	1 2 3 4 5 6 7 9	8	b	0					15.9	221
ovc	ast	r	-	-	1 2 3 4		c	0					1.3	112
ovc	ast	r	-	-	1 2 3 4		c	0					2.0112	112
ovc	cal	l	u	-	1		b	0					0.2	112
ovc	cal	L	u		1		b	0					0.4	378
ovc	cal	L	f			2 3	b	0					1.4	620
ovc	cal	L	u		2 3	4	b	0					1.6	205
ovc	cal	R	u		1		b	0					0.3	147
ovc	cal	R	u		1		b	0					0.2	147
ovc	cal	R	u		1		b	0					0.4	816
ovc	cal	R	u		2		b	0					0.9	182
ovc	cal	R	n			2 3 5	b	0					0.7	37
ovc	cal	r	u	-	1		b	0					0.1	112
ovc	cal	R	u		2 3 4	5	b	0					2	164
ovc	cal	l	u	-		2	b	0					0.3	112
ovc	cal	l	u	-	1		b	0					0.1	112
ovc	cal	l	u	-	2		b	3		3 km	2		0.7	454
ovc	cal	l	u	-	2	3 4	b	0		4 fm	2		1.4	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	cal	r	u	-	1		b	0					0.3	112
ovc	cal	r	u	-	1		b	0					0.4	315
ovc	cal	r	u	-	1		b	0					0.3	441
ovc	cal	r	u	-	2	3	c	0					1.1	112
ovc	cal	R	u		1		b	0					0.2	164
ovc	dph	L	f		1 2		b	0					0.3	160
ovc	dph	R	f		1 2		b	0					0.6	378
ovc	ep	-		u	1 2 3 4		b	0					7.9	427
ovc	ep	-		n		1	b	0					0.6	363
ovc	ep	-		n		1	b	0					3.2	884
ovc	ep	-		u	1 2 3 4		b	0					5.4	112
ovc	ep	-		n		1	b	0					3	250
ovc	ep	-		n	1		b	0		1 cm	1		3.2	112
ovc	ep	-		n	1		b	0		4 cm, 2 kn	1		7.3	379
ovc	ep	-		n		1	b	0					1.2	363
ovc	ep	-		u	1 3 4		c	0					7	38.1
ovc	ep	-		n	1		c	0					2.3	99
ovc	ep	-		n	1		b	0					4.7	288
ovc	fe	l	n	n	3 6 7 8	5	b	0		3 fm	8		7.1	615
ovc	fe	L	n	fu	9 # @	7 8	b	0					9.8	365
ovc	fe	R	fu	n	1 2 5	3	b	0					9.5	173
ovc	fe	R	n	u	9 # @		c	0					3.2	435
ovc	fe	l	n	n	6 7 8	3	b	0					8.2	355

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	fe	L	f	n	4	3	b	0					3.1	443
ovc	fe	l	u	n	5		b	0					1.5	112
ovc	fe	l	u	n		5	b	0					0.2	112
ovc	fe	r	u	n	2 3 6 7 8		b	0					6.4	454
ovc	fe	r	u	n	4		b	0					1	148
ovc	fe	L	n	u	9 # @		c	0					2.5	378
ovc	fe	l	u	n		5	b	0					0.5	285
ovc	fe	l	n	n	7 8	6	b	0					9.6	112
ovc	fe	l	n	n	#		b	2					1	328
ovc	fe	r	n	n	8	7	b	0					2.9	36.4
ovc	fe	r	u	n	3 6	7 8	b	0					2.8	53
ovc	fe	L	n	u	9 # @		c	0					2.9	466
ovc	fe	l	u	n	4		b	0					0.6	285
ovc	fe	r	u	n	4		b	0					1.3	831
ovc	hu	L	n	f	3 4 5 6	7 8	b	0		? fm	lat 7	? Last no??	5.7	100
ovc	hu	L	fu	n	1 2 @		b	0					7.9	209
ovc	hu	L	f	n	2 9 # @	1	b	0		3 fm	9		9.9	209
ovc	hu	L	n	f	3 4 5 6	7 8	b	0				(812?)	4.5	718
ovc	hu	L	u	n	@	9 #	b	0					3.4	37
ovc	hu	L	u	n	2		b	0					1	37
ovc	hu	L	u	n	1		c	0					1	37
ovc	hu	L	f	n	1 2 @		c	0					7.2	120
ovc	hu	L	n	fu	3 4 5 6 7	8	b	0		fm	lat 7		4.2	107

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	hu	L	n	n	3 4 5 6		b	0					1.9	98
ovc	hu	R	n	fu	3 5 6	4 7 8	c	0					2.7	620
ovc	hu	R	f	n	1	@	b	0					3.4	364
ovc	hu	R	f	n	1 2 @		b	0					6.1	38
ovc	hu	R	n	f	3 4 5 6	7 8	b	0					3.7	284
ovc	hu	R	u	f	5 6 7 8 9 # @		b	0					9.4	378
ovc	mc	L	n	u		7 8	b	0					0.9	173
ovc	mc	L	n	u		7 8	c	0					2.2	199
ovc	mc	R	f	n	1	2 5 6	b	0					1	154
ovc	mc	R	f	n	1	5	b	0					1.4	112
ovc	mc	r	n	u		7 8	b	0					1.4	112
ovc	mc	L	f	n	2	1	b	0					1.6	363
ovc	mc	L	f	n	1 2	5 6	b	0					1.7	92
ovc	mc	L	f	n	1 5	2	b	0					1.5	164
ovc	mc	r	f	n	2	1 5 6	c	0	gn				1	112
ovc	mc	L	f	u		2 6 8	b	0					5.4	852
ovc	mc	-	n	u	£		b	0					1	422
ovc	mc	r	f	n	1 2 6	5	c	0		4 dm	1		3.9	315
ovc	mc	R	f	n	1	2 5 6	b	0					2.9	397
ovc	mc	L	n	u		7 8	b	0					1.4	423
ovc	mc	L	n	u		8	b	0					1.3	466
ovc	mc	L	f	n	1	2 5	b	0					1.1	653
ovc	mc	L	u	u	5 7		b	0				Not fused vertic	1.1	221

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	mc	R	u	u	6 8		b	0					0.7	221
ovc	mc	l	n	f	3 4	7 8	c	0		1 dm	4		1.8	379
ovc	mc	L	n	u	3 4		a	0					3.2	227
ovc	mc	-	n	u	£	&	c	0					2.2	173
ovc	mc	L	u	n	6	8	b	0					0.4	199
ovc	mc	L	u	u	6 8		b	0					1	335
ovc	mc	L	u	u	6 8		b	0					1.6	221
ovc	mc	L	f	n		1 4	b	0	gn?	7 fm	5		1.7	462
ovc	mc	R	f	n		2 6	b	0					0.4	39
ovc	mc	l	n	f	3 4	7 8	c	0		2 dm, 2 dm	7, 8		3	884
ovc	mc	R	n	n		6 7 8 9	b	0	gn				0.7	199
ovc	mc	R	u	n	6	8	b	0				Not fused vertic	0.5	199
ovc	mc	R	n	u	3 4		b	0					2.1	466
ovc	mc	l	f	n	1 2 5 6 7 8		b	0		2 fm, 5 fm,	5, 6		9.6	426
ovc	mc	l	f	n	1 2 5 6		c	0					5.2	50
ovc	mc	l	n	u	7 8		b	0					5.3	379
ovc	mc	L	n	u	7	5	b	0		fm	7		2.7	363
ovc	mc	L	n	n		5 6 7 8	c	0					6.9	54
ovc	mc	L	f	n	1 2	5 6	b	0					2.8	199
ovc	mc	L	u	u	5 6 7 8		b	0					2.9	653
ovc	mc	L	u	u	6 8		b	0				Not fused vertic	1.4	221
ovc	mc	l	f	n	1 2	5 6	b	0					2.8	315
ovc	mc	L	n	u	6 7 8	5	b	0					1.2	574

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	mc	R	f	n	1	2 5 6	b	0					1.3	205
ovc	mc	R	n	u		7	b	0					1.4	92
ovc	mc	L	n	u	8	7	b	0					1.5	363
ovc	mc	R	u	u	5 6 7 8		b	0					2.9	101
ovc	mc	L	n	u		7 8	b	0		fm	7 / 8		2	823
ovc	mc	R	f	n	2	1 5 6	b	0					2.4	175
ovc	mc	l	f	n	1 2	5 6	c	0					2.4	53
ovc	mp	-	n	u	$		b	0					0.5	315
ovc	mp	-	n	f		$ £	b	0					0.7	209
ovc	mp	-	n	u	$		b	0					1	99
ovc	mp	-	n	u	£		b	4				Burnt	0.8	285
ovc	mp	-	n	u	$		b	0					0.5	622
ovc	mt	R	u	n	5 6	7 8	b	0					1.9	378
ovc	mt	l	u	n	5 6		b	0					1.6	315
ovc	mt	l	f	u	2	6	b	0					1.4	653
ovc	mt	l	f	f	1 2 3 4 5 6 7 8		c	0					20.7	64
ovc	mt	L	f	n		1 2 5 6	b	0					0.9	378
ovc	mt	L	u	u	5 6 7 8		b	0					3.9	355
ovc	mt	L	n	u	7 8		b	0		dm (sm?)	7 8		2.4	355
ovc	mt	-	n	f	3 4	7 8	b	0					2.5	626
ovc	mt	l	f	n		2 6	b	0					1.2	112
ovc	mt	R	f	n	1	5	a	0					2.2	364
ovc	mt	l	f	n		1 2 5	b	0					1.1	250

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	mt	R	u	u	5 6 7 8		b	0					3.9	355
ovc	mt	R	n	u	7 8		b	0					0.7	496
ovc	mt	R	f	n		1 5	b	0					1.2	160
ovc	mt	R	f	n	1 2 5 6 7 8		b	0					11.8	149
ovc	mt	R	n	u		7 8	b	0					0.4	612
ovc	mt	R	f	n		1 2 5 6	b	0					2.1	92
ovc	mt	r	n	u		8	c	0					3	526
ovc	mt	L	f	n	2	6	b	0					1.7	620
ovc	mt	-	n	u	£		b	0					1.9	173
ovc	mt	L	f	n	1	6	b	0					1.5	620
ovc	mt	r	f	f	1 2 3 4 5 6 7 8		c	0	gn	5 fm, 2 fm, 5 fm	5, 6, 7		20.2	50
ovc	mt	-	f	n		1 5	b	0					1.4	53
ovc	mt	L	f	n	1 2 5 6	7 8	b	0					6.6	355
ovc	mt	L	u	n	5 6	7 8	b	0					2	173
ovc	mt	L	f	n		2 6 8	b	0		5 fm	8		3.4	66
ovc	mt	L	f	n		1 2 5 6	b	0					2.1	616
ovc	mt	L	f	u	1 2 5 6 7 8		c	0					7.7	522
ovc	mt	L	f	n	1 2 5 6 7 8		c	0					9.8	425
ovc	mt	l	f	n		1 2 5 6	b	0					0.9	112
ovc	mt	L	f	n	2	1 5 6	b	0					1.6	398
ovc	mt	l	f	n	1 2	5 6	b	0					4.5	230
ovc	mt	R	f	n		1 5 7	b	0					2.3	112
ovc	mt	L	u	n	5 6		b	0					1.4	495

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	mt	L	n	n	5 6 7 8		b	0					1.7	388
ovc	mt	R	n	n	5 6	7 8	b	0					4	638
ovc	mt	R	f	n	1 2 5 6		b	0					2.1	620
ovc	mt	r	f	n	1 2	5 6	b	0					1.5	112
ovc	mt	R	f	n	1 2 5	6	b	0					3.6	88
ovc	mt	R	f	n	1 5	7	a	0					6.1	200
ovc	mt	r	f	n		1 2 6	b	0					0.7	164
ovc	pe	L	u		2 4	6	b	0					0.8	653
ovc	pe	L	u		2 5	7 #	b	0					1	378
ovc	pe	L	f		1 2 4	5 6	b	0					3.1	205
ovc	pe	l	n	-	3	8	b	0		1 dm	8		0.6	650
ovc	pe	L	f		3 8 9		b	0					1.3	378
ovc	pe	L	f		2 4	6	b	0					1.4	620
ovc	pe	L	f		3 8		b	0					1.1	388
ovc	pe	L	f		2 4	3 6	b	0					1.5	56
ovc	pe	L	f		3 8		b	0					0.7	112
ovc	pe	r	u	-	1 5		b	0					3.5	112
ovc	pe	r	f	-	3	8	c	0					0.5	112
ovc	pe	r	f	-	3	1 8	b	0					1.7	64
ovc	pe	l	n	-	3	8	c	0					0.6	112
ovc	pe	R	f		1 5	4	b	0					2.1	99
ovc	pe	l	n	-	3	8	b	0					0.6	112
ovc	pe	r	f	-	1	2	b	0					1	575

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	pe	R	f		1 2 3 4 5 6 8 9 # @	7	b	0					17.7	378
ovc	pe	r	f	-	1	3 5	b	0					2.2	250
ovc	pe	l	f	-	2 4 6	3	b	0					2.2	112
ovc	pe	r	u	-	3	8	c	0					0.8	261
ovc	pe	r	n	-	3 8		c	0					0.8	112
ovc	pe	r	f	-	2 4 6	@	b	0					2.2	112
ovc	pe	L	f		2 4 6		c	0					1.3	288
ovc	pe	R	f		1 2 3 4 5 6	8 #	b	0					9.1	147
ovc	pe	R	f		3 8	1 9	b	0					0.9	512
ovc	pe	R	f		1 2 3 4 5 6 7 8 #	@	b	0					8	148
ovc	pe	r	n	-	1		b	0					0.2	112
ovc	pe	l	u	-	1 5	7 #	b	0					3.1	112
ovc	pe	r	f	-	2 4 6	1 @	b	0					2.3	112
ovc	pe	r	f	-	2 4 6	1 @	c	0					4.2	50
ovc	pe	r	f	-	1 5	3 7 #	b	0					3.5	112
ovc	pe	r	n	-	1 5		b	0					3	112
ovc	pe	r	u	-	3	8	c	0		1 dm	8		0.7	112
ovc	pe	r	n	-	3 8		b	0					0.3	227
ovc	pe	r	f	-	1 2 4 5 6		b	0					3.9	285
ovc	pe	R	f		3 8	2	b	0					1.4	251
ovc	pe	L	f		2 4 6 @	1	b	0					3.5	378
ovc	pe	L	f		1 5	#	b	1					3.7	211
ovc	pe	r	n	-	2 6	4	b	3				burnt	1.2	749

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	pe	L	f		1 2 4 5 6 #	7	c	0	gn				10.5	435
ovc	pe	L	f		1 2 3 4 5 6	8	b	0					9.3	653
ovc	pe	R	f		3 8		b	0					0.6	410
ovc	pe	l	f	-	2 4 6	1 @	b	0					4.1	58
ovc	pe	R	f		3 8	1	b	0					1	199
ovc	pe	R	f		1 2 3 4 5 6 8		b	0					13.3	99
ovc	pe	R	f		3 8	1	b	0					1.6	38
ovc	pe	R	f		2 4 6		b	0					1.7	112
ovc	pe	r	f	-	3 8	6	b	0					0.9749	334
ovc	pe	R	f		2	4 6	b	0					1	410
ovc	pe	R	f		1 5	2 7 #	b	0					2.7	54
ovc	pe	R	f		2 4 6	1 @	c	0					3.4	512
ovc	pe	R	f		1 2 3 4 5 6 8	@	b	0					5.2	173
ovc	pe	R	f		2 4 6 @	1	b	0					4.3	175
ovc	pe	R	f		1 2 3 4 8	5 6	b	0					6.8	603
ovc	pe	R	f		3 8		b	0					0.6	1000
ovc	pph	L	u		1		b	0					0.1	315
ovc	pph	L	f		1	3	b	0					0.7	620
ovc	pph	L	n		2 3		c	0		2 fm	3		0.7	620
ovc	pph	L	u		2 3		b	0					0.3	626
ovc	ra	r	n	n	6		a	0		3 kn	6		2.1	363
ovc	ra	R	f	n	2	5	a	0	-			-	3.1	425
ovc	ra	R	n	u	9 #	8	b	0					2.4	423

Species	Element	Side	Prox	Dist	Frag(>50%)	Frag(<50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	ra	L	n	n	6 7 8	5 9 #	c	0	gn			-	4.2	173
ovc	ra	R	n	u	8	5 9	a	0				-	6.4	226
ovc	ra	L	n	n	6 7 8	5 9 #	c	0	gn			-	5.5	34
ovc	ra	L	-	f	-	8 9 #	b	0		3 dm	8 10 lat, vo	-	6.1	188
ovc	ra	R	n	n	6 7 8	5 9 #	c	0					7.8	59
ovc	ra	l	f	n		2 5	b	0					0.9	261
ovc	ra	l	f	n		2 5	b	0					2.8	246
ovc	ra	R	n	u	9 #	8	b	0					2.9	398
ovc	sc	L	f	f	1 2 3		c	0					1.5	101
ovc	sc	L	u	u	1 2 3 4 5		b	0					2.3	227
ovc	sc	L	u	n	1 2 3 4 5	6 7	b	0					2.7	37
ovc	sc	L	f	f	1 2 3 4 5		b	0					3.9	365
ovc	sc	L	f	n	1 2 3 4 5	6 7	d	2					9.7	435
ovc	sc	L	f	n	1 2 3 4 5	7	c	0					11.2	36
ovc	sc	L	f	n	1 2 3 4 5 6 7		b	0					6.9	171
ovc	tb	R	n	f	5 6 9 #		b	0					11.4	378
ovc	tb	r	n	f	5 6	#	b	0		1 dm	#		6.4	59
ovc	tb	R	u	n	1 2 3	4	b	0					1.2	601
ovc	tb	R	fu	n	1 2 3	4 7	b	0					3.9	26
ovc	tb	R	u	n	1 2 3 4		b	0					2.8	601
ovc	tb	R	u	n	1 2 3 4		b	0					2.8	439
ovc	tb	R	u	n	1 2 3	4	b	0					1.5	281
ovc	tb	R	n	u	5 6		b	0					0.8	365

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	tb	L	n	f	5 6 #		c	0					4.3	466
ovc	tb	R	n	f	5 6 9 #	8	b	0					15.3	466
ovc	tb	L	n	f	5 6 #	9	b	0					7.5	423
ovc	tb	L	fu	n	1 2 3 4 7	8	b	0		2 dm	3		15.4	173
ovc	tb	L	f	n	1 2 3 4 7	8	b	0					9.5	363
ovc	tb	R	u	n	7 8 9		b	0					19.2	423
ovc	tb	r	n	f	5 6 #	9	b	0					12	50
ovc	tb	L	n	f	5 6 #		b	0					3.6	363
ovc	tb	L	f	n	1 2 3 4 7	8	b	0					8.1	72
ovc	tb	L	f	n	#	9	b	0					5.6	129
ovc	tb	r	n	u	5 6		b	0					1	112
ovc	tb	L	f	n	5 6		b	0					2.1	129
ovc	tb	L	f	n	7		b	0					4	388
ovc	tb	L	f	n	1 2 3	4	b	0					2.6	378
ovc	tb	L	f	n	1 2 3	4	b	0					3.4	186
ovc	tb	L	u	n		7 8 9	b	0					25.4	188
ovc	tb	L	u	u	7 8 9 #		b	0					12.9	378
ovc	tb	r	n	f	5 6	#	b	0					3	53
ovc	tb	r	n	u	5 6		b	0					1.6	454
ovc	tb	r	n	u		#	b	0					2	454
ovc	tb	r	n	f	5 6 #	9	b	0					9.4	53
ovc	tb	R	n	f	5 6 8 9 #		b	0					10.9	120
ovc	tb	R	n	u	5 6		c	0					0.8	44

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
ovc	tb	L	n	f	5 6 9 #		b	0					7	21
ovc	tb	R	n	f	5 6 #	9	b	0					8.4	363
ovc	tb	R	n	f	5 6 #	9	b	0					6.6	284
ovc	tb	R	n	f	5 6 #		b	0					6.7	20
ovc	tb	R	n	f	5 6 #		b	0					3.9	205
ovc	tb	R	n	f	5 6 #		b	0					4.9	379
ovc	ul	R	n		B C D	E	b	0					1.5	96
ovc	ul	L	u		B C D		b	0					3.3	365
ovc	ul	R	n		C D E	B	c	0					2	508
ovc	ul	R	u		B C D E		b	0					1.6	653
ovc	ul	R	u		B C D E		c	0					1.9	355
ovc	ul	L	u		A B C D E		b	0					3.9	188
ovc	ul	L	u		B C D E F		c	0					6.1	0
ovc	ul	R	u		B C D		c	0					1.1	101
ovc	ul	L	u		C D	E	b	0					2.1	97
ovc	ul	L	u		D	C	b	0					0.7	284
ovc	ul	L	u		B C D	E	b	0					2	148
slm	fe	-	n	u	9 # @		a	0					0.3	653
slm	pe	L	u		1 5		b	0					0.5	653
slm	pe	R	n		1	5	b	0					1.3	219
slm	sc	R	u	u	1 2 3 4 5	7	b	0					0.4	378
slm	ul	L	u	n	B C D	E	b	0	-			Young	0.6	626
slr	fe	R	n	u	7 8		b	0					5.5	365

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	fe	R	n	u	7	8	b	0					4.5	53
slr	fe	R	u	u	2 3 5 6 7 8		b	0					2.4	355
slr	fe	R	u	n	1		b	0					0.5	466
slr	fe	R	u	u	2 3 5 6 7 8		b	0				Path, twisted	4	122
slr	fe	R	u	u	2 3 5 6 7 8		b	0					3.2	26
slr	fe	R	n	u		7 8	a	0					5.2	205
slr	fe	R	u	u	2 3 5 6 7 8		b	1					3.8	209
slr	fe	L	n	u	6 7 8	3	b	0					3	388
slr	fe	R	u	n	2 3 5	6	b	0					2.8	466
slr	fe	L	u	u	2 3 5 6 7 8		b	0				neo	2.5	199
slr	fe	L	u	n	2 3 5	6	b	0				neo	1	620
slr	fe	L	u	n	2 3 5	6	b	0					1.2	199
slr	fe	L	u	n	2 3 5		b	0					1.5	388
slr	fe	R	u	n	4		b	0					0.8	363
slr	fe	R	u	n	4		a	0					1.1	653
slr	fe	L	u	n	4		b	0					0.6	653
slr	fe	-	u	n	4		b	0					0.4	101
slr	fe	-	u	n	4		b	0					1.1	378
slr	fe	-	u	n	4		b	0					0.8	34
slr	fe	L	n	n		@	c	0					3	98
slr	hu	L	u	n	@		b	0					1.7	149
slr	hu	L	u	n	2		b	0					1.2	378
slr	hu	L	n	n	9 #	7 8	b	0					3.8	604

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	hu	R	u	n	11		b	0					3.1	435
slr	hu	R	u	n	7 8 9 # @		b	0					5	612
slr	hu	R	n	n	7 8 9 #	@	b	0					2	620
slr	hu	L	u	n	1		b	0					1.4	378
slr	hu	L	n	f	3 5	4 6 7	b	0				(812?)	2.6	817
slr	hu	L	u	n	2		c	0					1.4	620
slr	hu	L	u	u	7 8 9 # @		b	0		? fm			1.8	626
slr	hu	L	n	u	5 6		b	0				neo	1.9	363
slr	hu	L	u	n	1		b	0				neo	1.2	147
slr	hu	L	fu	u	2	1 @	b	0					2	388
slr	hu	L	u	n	1		b	0					0.7	101
slr	hu	L	u	n	1		d	0					0.7	563
slr	hu	L	u	n	2		b	0					1.2	388
slr	mc	r	f	n		2 6	c	0					1.8	454
slr	mc	l	n	n		6	b	0		3 fm	6		0.9	431
slr	mc	l	f	n	2	6	b	0					0.8	112
slr	mc	l	f	n	1	5	b	0					1.4	250
slr	mc	r	n	n	5	7	b	0				neonatal	0.6	1002
slr	mc	-	n	u		$	b	0					0.4	285
slr	mc	-	n	u		$	c	0					0.5	112
slr	mc	-	n	u		£	c	0				neonatal	0.8	250
slr	mc	r	u	n	6 8		b	0				neonatal	1	1002
slr	mc	-	n	f		7 8	b	0					0.8	261

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	mc	r	f	n		1 2	c	0					0.7	250
slr	mc	r	f	n		2	c	0					0.1	112
slr	mc	r	f	n		1 2 6	b	0		2 fm	6		1.3	250
slr	mc	-	n	n		7 8	b	0					1.1	250
slr	mc	r	u	n	5 6		b	0		1 dm	2	neonatal	1.4	884
slr	mp	-	n	u		£	b	0					0.3	112
slr	mp	-	n	u		$	c	0				burnt	0.3	112
slr	mp	-	n	u		£	b	0					0.3	112
slr	mp	-	n	u		£	b	0		2 fm	£		0.8	250
slr	mp	-	n	u		£	b	0		1 km	£		0.6	431
slr	mp	-	n	u		£	b	0					0.9	481
slr	mp	-	n	f	$	£	c	0					1	441
slr	mp	-	n	u	$		c	0					0.3	112
slr	mp	-	n	u	£		b	0					0.3	112
slr	mp	-	n	u	$		c	0					0.3	112
slr	mp	-	n	u	$		b	0					0.7	58
slr	mp	-	n	n		$	b	0				tiny frag, no wei	0	112
slr	mp	-	n	u		£	b	0					1.1	378
slr	mp	-	n	u		£	b	0					0.2	112
slr	mp	-	n	u		$	c	0					0.6	112
slr	mp	-	n	n	& £		b	0					0.6	250
slr	mp	-	n	u		7 8	b	0					0.4	250
slr	mp	-	n	u	$		c	0					0.2	112

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	mp	-	n	u		£	b	0					1.2	173
slr	mp	-	n	u		£	b	0					0.2	112
slr	mp	-	n	u	£		b	0					0.6	112
slr	mt	L	n	n		5 6	b	0					2.5	378
slr	mt	r	f	n		1 2 5 6	b	0					2.5	884
slr	mt	-	n	u	$		c	0					0.7	112
slr	mt	-	n	u	$		c	0					0.5	315
slr	mt	-	n	u	£	&	b	0					2.8	261
slr	mt	-	n	u	$		b	0					0.7	112
slr	mt	-	n	u	$		c	0					0.5	112
slr	mt	-	n	u	$		b	0					0.3	112
slr	mt	-	n	u	$		c	0					0.4	112
slr	mt	-	n	u	$		b	0					0.4	285
slr	mt	-	n	u	$		d	0					0.3	112
slr	mt	r	u	n	7 8		b	0					0.5	378
slr	mt	r	f	n		1 2 5 6	b	0					1	112
slr	mt	r	f	n		2 6	b	0					1.3	431
slr	mt	r	f	n		1 2 5 6	b	0					0.3	112
slr	mt	r	f	n		1 5	b	0					0.3	112
slr	mt	l	f	n		2 6	b	0					0.3	112
slr	mt	r	f	n		1 2 5 6	b	0					0.7	112
slr	mt	r	f	n		2 6	b	0					0.4	112
slr	mt	l	f	n		1 5	b	0					1.3	441

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	pe	L	u		1 5	7 #	b	0				(029?)	1.7	620
slr	pe	l	f	-	1 4 5 6	2	b	0					4.8	884
slr	pe	l	n	-	2 6	4	b	0					0.8	112
slr	pe	l	u	-	2 6	4 @	b	0					0.5	53
slr	pe	l	n	-	3	8	b	0					0.6	112
slr	pph	l	f	n		1 3	b	0					0.2	112
slr	pph	l	u			3	c	4				burnt	0.1	112
slr	pph	l	u	-		1	c	4				burnt	0.1	112
slr	tb	R	u	u	7 8 9 #		b	0					3.9	620
slr	tb	R	n	u	#	9	b	0					2.9	112
slr	tb	L	n	n	7 8		c	0	gn	12 fm	7		9.5	112
slr	tb	L	n	n	7 8 9		b	0					8.6	363
slr	tb	L	n	u	8 9 #		b	0					4.7	388
slr	tb	L	u	u	7 8 9 #		b	0					4.2	200
slr	tb	L	n	u	8 9 #		b	0					2.1	199
slr	tb	r	n	u	5 6		b	0					0.5	112
slr	tb	R	u	u	7 8 9 #		b	0					10.7	201
slr	tb	R	n	fu	5 6 9 #		c	0					12.3	54
slr	tb	R	n	u	9 #		b	0					9.1	188
slr	tb	R	u	n		7 8	b	0		fm	7		5.9	620
slr	tb	R	n	n		7 8	b	0					3.2	397
slr	tb	R	n	u		#	b	0					1.8	443
slr	tb	R	n	n		7	b	0					1.4	164

Species	Element	Side	Prox	Dist	Frag(> 50%)	Frag(< 50%)	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Con
slr	tb	R	n	u	5 6		b	0				neonatal	0 4	620
slr	tb	R	f	n	1	4	b	0					3	9
slr	tb	L	n	f		5 #	b	0					0.7	822
slr	tb	r	f	n	2 3	7	b	0					1.9	148
slr	tb	l	n	f	5 6 9 #		b	0					9.7	53
slr	tb	l	n	f	5 6 #	9	b	0		5 fm	9		10.4	53
slr	tb	l	n	n		7 8 9	b	0					4.8	53
slr	tb	r	u	n		7	b	0					1.9	315
slr	tb	l	n	fu	5 6	#	c	0					1.5	112
slr	tb	l	n	u	5 6		b	0					1	112
slr	tb	R	n	u	8 9 #		c	0					2.2	284
slr	tb	r	n	n		7	b	0					1	112
slr	tb	R	u	n	7 8 9		b	0					3.1	355
slr	tb	r	n	n	8 9		b	0		21 fm	9		14.3	379
slr	tb	r	n	u		#	b	0					0.6	112
slr	tb	r	n	u		9 #	b	0					3.9	173
slr	tb	r	n	u	9 #		b	0					4.6	112
slr	tb	r	n	u	5 6		b	0					0.9	112
slr	tb	l	n	u		#	b	0					1.9	112
ss	hu	L	n	f	3 4 5 6	7 8	b	0					22.4	53
ss	tb	l	n	u	6	5	b	0					1.8	53
ui	ra	R	n	n	6	7 8	b	0		-		-	5	429

Cranial bones from Beirgh

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	dp3	r		1 2		b	0				1.4						
bt	dp3	r	-	1 2		b	0				3.1						
bt	dp4	r		2		b	0				2.8	c					
bt	dp4	l		2		b	0				3 8	c					
bt	dp4	l	0 - 1 mo	2	1	b	0				5.4	a					
bt	dp4	l	0 - 1 mo	2		b	0				4.3	b					
bt	dp4	l	0 - 1 mo	2		b	0				3	b					
bt	dp4	l		1 2		b	0				5.9	f					
bt	dp4	l	0 - 1 mo	1 2		b	0				5.5	b					
bt	dp4	l	0 - 1 mo	1 2		b	0				4.4	b					
bt	dp4	l	0 - 1 mo	2	1	b	0				1.3	a					
bt	dp4	l	0 -1 mo	1 2		b	0				5.4	b					
bt	dp4	r		1 2		b	0				5.2	c					
bt	dp4	r		1 2		b	0				7.7	k					
bt	dp4	r	0 - 1 mo	2	1	b	0				4.7	a					
bt	dp4	r	0 - 1 mo	2	1	b	0				3	b					
bt	dp4	r	0 - 1 mo	2	1	b	0				5.1	b					
bt	dp4	r	0 - 1 mo	1 2		b	0				5.3	b					
bt	dp4	r	0 - 1 mo	2	1	b	0				3.5	b					
bt	dp4	r	0 - 1 mo	2	1	b	0				5	a					

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	dp4	l		2		b	0				1 2	c					
bt	dp4	l		1 2		c	0				4.7	j					
bt	M3	r	young adult	1 2		b	0				26 1						f
bt	M3	r		1 2		b	0				15						e
bt	M3	r	old adult	1 2		b	0				23.2						j
bt	M3	r	senile	1 2		b	0				23.5						k
bt	M3	r	young adult	1 2		b	0				26.2						f
bt	M3	r	young adult	1 2		b	0				25.2						e
bt	M3	r	senile	1 2		b	0				21.9						m
bt	M3	l	senile	1 2		b	0				28.6						k
bt	M3	l	18 - 30 mo	2		b	0				23.2						b
bt	M3	l	young adult	2		b	0				23.2						e
bt	M3	r	senile	1 2		c	0				12 9						k
bt	mn	r		5	3	b	0				17.7						
bt	mn	l		5	3	b	0				16.2						
bt	mn	l			6	b	0				7.3						
bt	mn	r		3 5	4 6	b	0		5 kn		18.1						
bt	mn	r		3 4 5		b	0				15.5						
bt	mn	l		7	2	b	0				8.5						
bt	mn	-		1		c	0				8.4						
bt	mn	l	juv	5	3	b	0				5.5						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	mn	r		5	3 6	b	0				25 4						
bt	mn	r		2 7		b	0		7 fm		17 1						
bt	mn	r		4 5	3 6	d	0				25 8						
bt	mn	r		5	3	c	0				11 4						
bt	mn	r		3 4 5		b	0		2 cm, 4 c		15 8						
bt	mn	l			6	c	0				7 7						
bt	mn	r		1		c	0				34 6						
bt	mn	r		6		b	0				20 6						
bt	mn	l	neonat	3 5	4	c	0				3.7						
bt	mn	l			2	c	0				5						
bt	mn	r		2	1 7	b	0			P2	26 4						
bt	mn	r			1	c	0				35 9					k	
bt	mn	r	> 1 - 8 mo		1	b	0				27.9	g					
bt	mn	r		1 2		c	0		8 km, 6 k		48 2	f					
bt	mn	r		2	1 7	b	0			dp2	13.9						
bt	mn	r			1 2	b	0				11 2						
bt	mn	r		3 5	6	b	0		2 fm		48.4						
bt	mn	r		1		b	0			dp2 - 3	6						
bt	mn	r	> 1 - 8 mo		1 2	b	0				20.9	f					
bt	mn	r		2	1	b	0			dp2	20 2						
bt	mn	l		5		c	0				9 1						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	mn	l			1	c	0				5.3						
bt	mn	l		3 5	4 6	c	0			neonate	8.5						
bt	mn	l		4		b	0				9.5						
bt	mn	r	12 - 18 mo		1	c	1				28.2			osm	e		
bt	mn	r	0 - 1 mo	1 3 4 5 6		b	0				22.5	a					
bt	mn	l			1	c	0				15.1						
bt	mn	r			1	b	0				22.1						
bt	mn	l	senile		1 6	c	0		2 km		41.4						k
bt	mn	l			6	b	0				14.9						
bt	mn	r			1	c	0			dp 2 present	6.5						
bt	mn	-		1	2	c	0				16.4						
bt	mn	r		1		b	0				6.1						
bt	mn	l			1 6	b	0				51.1						
bt	mn	l			1 2	b	0				9.8						
bt	mn	l		5 6	1	b	0				48.1						
bt	mn	l	24 - 36 mo		1	d	0				42.3		u	j			
bt	mn	l	adult		1 6	c	0				18.6						g
bt	mn	l	young adult	1		c	0				20.6				e		f
bt	mn	l	young adult	1	6	c	0				23.2				f		f
bt	mn	l		2 7		c	0		1 km, 2 k		37						
bt	mn	l	> 18 - 30 mo	1		b	0				62.4		h	n	k		

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	mn	l		4		b	0				8.7						
bt	mn	-		1	2	c	0				8.2						
bt	mn	l		4		b	1				19.1						
bt	mn	l		2	7	c	0		1 fm		15.9						
bt	mn	l		5	3	b	0				10.9						
bt	mn	l			5	b	0	gn			6.4						
bt	mn	l			1	b	0				7						
bt	mn	l		35		b	0				9.8						
bt	mn	l		4		b	0				8.7						
bt	mn	l		5		c	0	gn			11.3						
bt	mn	l		5	36	c	0				31.6						
bt	mn	r		7	2	b	0				6.9						
bt	mn	l		5	3	b	0				15.2						
bt	mn	l			6	b	0				26.5						
bt	mn	l		6		b	0				28.3						
bt	mn	l		27		b	0				21						
bt	mn	l		1		b	0				6.7			v			
bt	mn	l		1	2	b	0			neonatal, dp2, dp3 pres	5.4						
bt	mn	l		2		c	0				18						
bt	mn mol	l		12		b	0				12						
bt	mn mol	l		12		c	0				8.8						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	mn mol	l		1 2		b	0				12.4						
bt	mn mol	l		1 2		b	0				11.8						
bt	mn mol	l		1 2		b	0				10.7						
bt	mn mol	r		1 2		b	0				15.3					h	
bt	mn mol	r		1 2		c	0				7.6					l	
bt	mn mol	r		1 2		b	0				13.2					k	
bt	mn mol	r		1	2	b	0				6.5						
bt	mn mol	r		1 2		b	0				17					k	
bt	mn mol	r		1 2		b	0				9.3					l	
bt	mn mol	r		2	1	c	0				14.5					osm	
bt	mn mol	r		1 2		b	0				13.2					k	
bt	mn mol	r		2	1	c	0				9.1					j	
bt	mn mol	r		1 2		b	0				8.4					k	
bt	mn mol	l		2	1	b	0				9.1						
bt	mn mol	l		2	1	b	0				14.2					a	
bt	mn mol	l		1 2		b	0				20.7					g	
bt	mn mol	l		1 2		b	0				19.9					j	
bt	mn mol	l		2	1	b	0				10.6					d	
bt	mn mol	l		1 2		c	0				14					f	
bt	mn mol	r		1 2		d	0				9.7					k	
bt	mn mol	r		2	1	c	0				10.8					k	

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	mn mol	r		1 2		c	0				8.5					k	
bt	mn mol	r		1 2		c	0				9 7					l	
bt	mn mol	l		2		b	0				7.4					b	
bt	mn mol	r		1 2		b	0				12.9					d	
bt	mn mol	r		2	1	b	0				10.1					g	
bt	mn mol	r		1 2		b	0				19.3					osm	
bt	mn mol	r		1	2	b	0				4.2						
bt	mn mol	r		2		b	0				10.4					b	
bt	mn mol	l		2		b	0				4.2						
bt	mn mol	l		1		b	0				4						
bt	mn mol	r		1 2		c	0				17.5					j	
bt	mn mol	r		1 2		b	0				8.7					l	
bt	mn mol	r		1 2		b	0				21.6					f - g	
bt	P2	r		1 2		b	0				0.5						
bt	P2	l	-	1 2		b	0				1.5						
bt	P3	r		2	1	b	0			broken	3.7						
bt	P3	r		1 2		b	0				4.4						
bt	P3	r		1 2		b	0				2						
bt	P3	l		1 2		b	0				5.6						
bt	P3	l		1 2		b	0				3.9						
bt	P3	l			1	b	0				1.5						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
bt	P3	l		1 2		b	0				4.8						
bt	P4	r	f	1	2	b	0				2.6						
bt	P4	l	h	2	1	b	0				4.1						
bt	P4	l	f	1 2		c	0				4.1						
bt	P4	l	f	1 2		c	0				5						
bt	P4	l	a	1 2		b	0				1.6						
bt	P4	l	a	1	2	b	0				3.8						
bt	P4	l	c	1 2		b	0				5.9						
bt	P4	r	b	1 2		b	0				6.2						
bt?	mn	l		5	3 4 6	c	0			neonate	2.5						
ce	dp4	l		1	2	b	0				1.5	j					
ce	dp4	r			1 2	b	0				3.3						
ce	dp4	l		1 2		b	0				1.5						
ce	dp4	r			1 2	b	0				2.5						
ce	M3	l		1 2		b	0				7.2						
ce	M3	r		1 2		c	0				5.4						
ce	M3	l		1 2		b	0				11.8						
ce	M3	l		1 2		b	0				8.4						
ce	M3	l		1 2		c	0				5.2						
ce	M3	r		1 2		b	0				4.6						
ce	M3	r		1 2		b	0				4.9						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ce	M3	r		1 2		b	0				5.6						
ce	M3	l		1 2		b	0				8.2						
ce	mn	r			6	b	0				7.8						
ce	mn	l		4	3	c	0				3.9						
ce	mn	l		2 7	1	b	0				11						
ce	mn mol	l		1 2		b	0				7.1						
ce	mn mol	l		1 2		b	0				6.3						
ce	mn mol	r		1	2	b	0				4						
ce	mn mol	l		1 2		c	0				4.7						
ce	mn mol	l		1 2		b	0				5.3						
ce	mn mol	r		1 2		c	0				4.8						
ce	mn mol	l		2	1	b	0				3.3						
ce	mn mol	l		1 2		b	0				2.9						
ce	mn mol	r		1 2		b	0				3.7						
ce	mn mol	l		1 2		b	0				3.1						
ce	mn mol	l		1 2		c	0				3.1						
ce	mn mol	r		2	1	c	0				3						
ce	mn mol	l		2		b	0				2.4						
ce	P3	l	>9 yrs ? (P3)	1 2		b	0				1.8						
ce	P3	l		1 2		a	0				0.4						
ce	P3	l	1 - 2 yrs ?(P3)	1 2		b	0				1.9						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ce	P3	l	1 - 2 yrs ?(P3)	1 2		a	0				2						
ce	P3	r		1	2	b	0				0.7						
ce	P3	r		1 2		c	0				1.8						
ce	P3	l	-	1 2		b	0			occusal sfce broken	1.9						
ce	P4	l		1 2		b	0				2.3						
ce	P4	r	> 9 yrs	1 2		b	0				2.7						
ce	P4	r	5 - 6 yrs	1 2		b	0				2.6						
ce	P4	r	4 - 5	1 2		b	0				2.9						
ce?	mn	r		5	3 4 6	b	0				4.3						
hg	mn	r	no teeth	6	7	b	0				4.5						
hg	mn	r		6 7		c	0		3 fm		15.9						
lgr	dp3	l			1 2	b	0				2.1						
lgr	mn	r			1	b	0				1.7						
lgr	mn	r		3 4 5		b	0			neonatal	2.9						
lgr	mn	l	neonat	5 6	1	c	0				6.4						
lgr	mn	l		4		b	0				2.5						
lgr	mn	l		4		c	0				3.1						
lgr	Premolar	l		2	1	b	0				1.9						
oa	dp4	l		1	2	a	0				1.3	12L					
oa	mn	l		1 2	7	b	0				8	16L					
oa	mn	r		2	1	b	0			dp2, dp3 present	3						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
oa	mn	r		1 2 3 5 6	7	b	0				15 4	16L		2A	uE		
oa	mn	l			1 2	b	0			dp 2 present	4						
oa	mn	r		1 2 7		b	0		2 dm		14	13L		6A			
oa	mn	l		1 2 6 7		b	0			M2 not erupted	19.9	13L		1B	not		
oa	mn	r		1	2	b	0				5.1	13L		E			
ovc	dp3	l		1 2		b	0				0.3						
ovc	dp3	l		1 2		b	0				0.1						
ovc	dp4	l		1 2		b	0				0.8	16L					
ovc	dp4	r		1 2		b	0				1	13L					
ovc	dp4	l		1 2		b	0				1	17L					
ovc	dp4	r		1 2		b	0				1.2	brk					
ovc	dp4	l		1	2	b	0				0.4	16L					
ovc	dp4	r		1 2		c	0				2.8	-					
ovc	dp4	r		1 2		b	0				1.1	16L					
ovc	dp4	r		1	2	b	0				0.7	brk					
ovc	dp4	r		1	2	b	0				0.7	16L					
ovc	M1 / M2	l		1 2		b	0				3.6					5A	
ovc	M1 / M2	l		1	2	b	0				2.6					2A	
ovc	M1 / M2	l		1 2		b	0				3					brk	
ovc	M1 / M2	l		1 2		b	0				2.8					8A	
ovc	M1 / M2	r		1 2		b	0				4.4					8A	

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ovc	M1 / M2	l		1 2		b	0				4.8					7A	
ovc	M1 / M2	l		1 2		b	0				2.8					8A	
ovc	M1 / M2	l		1 2		b	0				1.5					9A	
ovc	M1 / M2	l		1 2		b	0				3.6					8A	
ovc	M1 / M2	r		1	2	b	0				1.9					3C	
ovc	M1 / M2	r		1 2		b	0				2					brk	
ovc	M1 / M2	r		1 2		b	0				2.5					7A	
ovc	M1 / M2	l		1 2		b	0				2.3					7A	
ovc	M1 / M2	r		1 2		b	0				1.4					brk	
ovc	M1 / M2	r		1 2		c	0			bit of mn attached	4.2					E	
ovc	M1 / M2	r		1	2	b	0				0.6					13A	
ovc	M1 / M2	r		1 2		b	0				1.2					12A	
ovc	M1 / M2	r		1 2		b	0				2.2					8A	
ovc	M1 / M2	r		1 2		b	0				1.9					9A	
ovc	M1 / M2	l		1 2		b	0				2.8					6A	
ovc	M1 / M2	r		1 2		b	0				1.8					9A	
ovc	M1 / M2	l		1 2		b	0				3.3					7A	
ovc	M1 / M2	l		1 2		b	0				1.8					9A	
ovc	M1 / M2	l		1 2		b	0				1.5					9A	
ovc	M1 / M2	l		1	2	b	0				1.6					0	
ovc	M1 / M2	l		1 2		b	0				0.8					15A	

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ovc	M1 / M2	l		1 2		b	0				1 9					4C	
ovc	M1 / M2	l		1 2		b	0				2.9					brk	
ovc	M1 / M2	r		1	2	b	0				1.9					9A	
ovc	M1 / M2	l		1 2		c	0				2					7A	
ovc	M1 / M2	r		1 2		b	0				2.4					8A	
ovc	M1 / M2	r		1	2	c	0				2.1						
ovc	M1 / M2	l		1 2		b	0				2.2					9A	
ovc	M1 / M2	l		1 2		b	0				1.7					3A	
ovc	M1 / M2	l		1 2		b	0				2.2					9A	
ovc	M1 / M2	l		1 2		b	0				1.9					9A	
ovc	M1 / M2	l		1	2	c	0				1.2					9A	
ovc	M1 / M2	r		1 2		b	0				1.9					brk	
ovc	M1 / M2	l		1 2		b	0				1.4					2C	
ovc	M1 / M2	r		1 2		b	0				1.7					5B	
ovc	M1 / M2	r		1 2		b	0				2.1					6A	
ovc	M1 / M2	r		1 2		b	0				4.1					6A	
ovc	M1 / M2	l		1 2		b	0				2.2					brk	
ovc	M3	r	11G	1 2		b	0				3.1						
ovc	M3	l	2A	1 2		b	0				6.5						
ovc	M3	l	9G	1 2		b	0				4.7						
ovc	M3	l		1 2		b	0				1.6						14G

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ovc	M3	r	5A	1 2		b	0				5.9						
ovc	M3	r	-	1 2		b	0			brkn	3.2						
ovc	M3	r	0	1 2		b	0				4						
ovc	M3	l	9G	1 2		b	0				6.5						
ovc	M3	l	5A	1 2		b	0				6.3						
ovc	M3	l	10G	1 2		b	0				5.4						
ovc	M3	r	9G	1 2		b	0				4.4						
ovc	M3 frag	r	-	1 2		c	0				4.7						
ovc	M3 frag	r	-	1 2		b	0				4.5						
ovc	M3 frag	l	-	1	2	c	0				3.2						
ovc	mn	r		1 2 7		b	1				27.6		4A	9A	7A		6A
ovc	mn	r			1	b	0			dp3 present	3.5						
ovc	mn	r		2 7	1	b	0				6.6	17L					
ovc	mn	l		2	1	b	0				3.2						
ovc	mn	r		6	1	b	0		1 dm		13.7						9G
ovc	mn	l		1 2 3 5 6 7		b	0				30.4			12A	9A		11G
ovc	mn	r		6 7		b	1				15.9			9A	E		
ovc	mn	r		3 4 5	6	b	0		km		4.7						
ovc	mn	l		2	1 7	b	0				3.1						
ovc	mn	r		1 2 7		b	0				7.4						
ovc	mn	r		5		b	0		2 dm, ch		3.1						

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ovc	mn	l		1 2	7	b	0				13.1		9A	brk			
ovc	mn	l	-	7	2	b	0				1						
ovc	mn	l	-	7	2	b	0				2.2						
ovc	mn	r			5	b	0			neonatal	0.5						
ovc	mn	r		5	3	b	0				1.3						
ovc	mn	r			1	b	0				1.4						
ovc	mn	r		4		b	0				1.7						
ovc	mn	r		1 2 7		b	0				33.1		7A	9A	5A		5A
ovc	mn	r		3 5	4 6	b	0				3.1						
ovc	mn	r	-	3 4 5 6		b	0				8.7						
ovc	mn	r	-	2 7	1	b	0		2 dm		4.6						
ovc	mn	l		5	6	b	0				2.9						
ovc	mn	r	-	5	3 6	b	0				1.9						
ovc	mn	r		5	3	b	0				1.8						
ovc	mn	l		5	3	c	0				4.6						
ovc	mn	l		5	3	b	0				1.7						
ovc	P2	l		1 2		b	0				1.4						
ovc	P4	r		1 2		b	0				0.6					12S	
ovc	P4	l		1 2		b	0				1					brk	
ovc	P4	r		1 2		b	0				0.7		12S				
ovc	P4	l		1 2		b	0				0.4		14S				

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ovc/ce	mn	l			7	d	0				9.1						
slr	mn	r		6		b	0				11.4						
slr	mn	r			1	b	0				1.9						
slr	mn	l		4		b	0			neonatal	0.6						
slr	mn	l		5	3 6	b	0				1.6						
slr	mn	l		5		b	0				1						
slr	mn	r			3 4 5	b	0				1.2						
slr	mn	r		4		b	0				1						
slr	mn	r		3 4 5 6		b	0				2.7						
slr	mn	r			3 4 5	b	0				2.1						
slr	mn	r		4		b	0				2.5						
slr	mn	l		2		b	0				1.4						
slr	mn	l			5	b	0				1.1						
slr	mn	l		4	3	b	0				1.3						
slr	mn	l		5	3	b	0				1.6						
slr	mn	l			1 2	b	0				0.9						
slr	mn	l				b	0				1.9					15A	
slr	mn	r		5	3 6	b	0				2.4						
ss	M1	r		1		b	0				1.5			a / U			
ss	M2	r		1 2		b	0				9				b		
ss	M3	r		1		b	0				9.9						a

Spcs	Ele	Side	Age	Frag(> 50%)	Frag(< 50%)	Pres	Stain	Gna	Butch	Other	Weight	dp4	P4	M1	M2	M1/M2	M3
ss	mn	l			1	c	0				0 9						
ss	mn	r		5		b	0		5 dm		10.3						
ss	mn	l		7		b	0		9 fm		15.9						
ss	mn	r		2	1	b	0				10.5						
ss	mn	l			1 6	c	0				29 6						
ss	mn	r			7	b	0			M2 present	13.8						
ss	mn	l			7	b	0			P3 & P4 present	8.7						
ss	mn	l			1	b	0			dp3 present	2.9						
ss	mn	r			7	b	0			M2, M3 present	16.4						
ss	P3	r		1 2		b	0				4.2						

Postcranial bone fragments from Beirgh

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	as	l			d	0					9 7	412
bt	as	l		1 2 3 4	c	0					30 9	380
bt	as	l		1 2 3 4	c	0					10 2	358
bt	as	l		1 2 3 4	b	0				young	11 6	356
bt	as	r		2	c	0					3 7	412
bt	as	r		1 2 3 4	d	0					11 1	358
bt	as	r		1 2 3 4	c	0					13 3	361
bt	as	r		1 2 3 4	d	0					18.3	362
bt	as	r		1 2 3 4	d	0					23.8	352
bt	as	r		1 2 3 4	d	0					16 5	361
bt	as	l		1 2 3 4	b	0		3 dm, 2 dm	1, 2		29.3	358
bt	as	r		1 2 3 4	c	0					31.9	273
bt	as	r		1 2 3 4	b	0					39 9	378
bt	as	r		1 2 3 4	c	0		5 dm	1		26.7	375
bt	as	r		1 2 3 4	d	0					19	246
bt	as	r		1 2 3 4	c	0		2 dm, 2 dm	1, 3		22.1	388
bt	as	r		1 2 3 4	c	0					31.6	273
bt	as	r		1 2 3 4	b	0					37.5	383

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	as	r		2 3 4	c	0					28.5	358
bt	as	r		1 2 3 4	c	0					7 4	358
bt	as	r		1 2 3 4	d	0					7	378
bt	as	r		1 2 3 4	c	0					9.6	281
bt	as	r		1 2 3 4	d	0					34.3	356
bt	as	l		1 2 3 4	c	0					24	356
bt	as	l		1 2 3 4	c	0					30.3	362
bt	as	l		1 2 3 4	c	0					49	358
bt	as	r		1 2 3 4	b	0					42.6	356
bt	as	l		1 2 3 4	c	0					23.8	281
bt	as	l		1 2 3 4	d	0					11	358
bt	as	l		1 2 3 4	d	0					29.9	362
bt	as	l		1 2 3 4	c	0					34.7	358
bt	as	l		1 2 3 4	d	0					18.8	361
bt	as	l		1 2 3 4	d	0					32.5	361
bt	as	l		1 2 3 4	b	0					23.4	361
bt	as	l		1 2 3 4	c	0					43.7	273
bt	as	l		1 2 3 4	b	0					44.4	273
bt	as	l		1 2 3 4	c	0					30.9	358
bt	as	l		1 2 3 4	d	1				burnt	21.2	365
bt	as	l		1 2 3 4	c	0					20.2	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	as	l		1 2 3 4	c	0		2 dm	1		43.8	356
bt	at	-	unfused	2	b	0					14.2	290
bt	at	-			c	0					11.2	362
bt	at	-		2	c	0					36.5	358
bt	at	-		1	b	0					36.6	383
bt	at			1	b	0					21.1	280
bt	at	-		1	b	0					26.5	378
bt	cal	r	< 36 - 42 mo	2 3 4 5	d	0					22.6	375
bt	cal	r	< 36 - 42 mo	1	c	0					3.6	358
bt	cal	r		1 2	c	0					5.2	356
bt	cal	l			b	0					1.3	356
bt	cal	l		2 3 4 5	c	1					29.9	375
bt	cal	l		2 3	c	0	gn				19.9	358
bt	cal	l	< 36 - 42 mo	2 3 4 5	c	0					10.2	358
bt	cal	l	< 36 - 42 mo	2 3 5	c	0					27.4	358
bt	cal	l	< 36 - 42 mo	2 3 4 5	c	0					34.4	380
bt	cal	r	> 36 - 42 mo	1 2 3 4 5	c	0					31.1	358
bt	cal	r	< 36 - 42 mo	2	d	0					6.6	354
bt	cal	r	> 36 - 42 mo	1 2 3 4 5	b	0					46.9	273
bt	cal	r	< 36 - 42 mo	2 3	b	0					2.3	246
bt	cal	r	< 36 - 42 mo	2 3	b	0		2 dm	2		7.3	273

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	cal	r		2 3	c	0				burnt	22.3	356
bt	cal	r	< 36 - 42 mo	2 3 4 5	b	0		1 dm	2		23	273
bt	cal	r		2 3 4 5	b	0					37.6	383
bt	cal	r	> 36 - 42 mo	1 2 3 4 5	b	0					49.3	381
bt	cal	r	> 36 - 42 mo	1 2 3 4 5	b	0		1 dm	4		66.7	358
bt	cal	l	< 36 - 42 mo	2 3 4 5	b	1		2 dm, 11 fm	2		42.3	381
bt	cal	r	< 36 - 42 mo	2 3 4 5	b	0		2 dm	3		24.2	273
bt	cal	l	< 36 - 42 mo	2 3 4	c	0					9.8	356
bt	cal	l	> 36 - 42 mo	1 2	c	0					10.6	352
bt	cal	l	< 36 - 42 mo	2 3	c	0					3.2	365
bt	cal	l	< 36 - 42 mo	2	c	0					27.9	352
bt	cal	l	< 36 - 42 mo	2 3 4 5	b	0					8.6	356
bt	cal	l	< 36 - 42 mo	2 3 4 5	b	0					35.5	356
bt	cal	l	< 36 - 42 mo	1	b	0					5.2	356
bt	cal	l	> 36 - 42 mo	1 2 3 4 5	b	0					56.1	358
bt	cal	l	> 36 - 42 mo	1 2 3 4 5	b	0					59.5	356
bt	cal	r	< 36 - 42 mo	1	d	0					2.5	273
bt	cal	r		2 3 4	d	0					14	361
bt	cal	r		2 3	c	0					17.1	363
bt	cal	r	< 36 - 42 mo	2 3 4 5	b	0					13.3	356
bt	cal	r	< 36 - 42 mo	2 3 4 5	c	0		2 dm	2		44.8	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	cal	r	< 36 - 42 mo	2 3 4 5	c	0					46	356
bt	cal	l	> 36 - 42 mo	1 2 3 4 5	b	0				calcitic accretions	45.8	361
bt	cal	l		3	c	0					5.2	356
bt	cal	l	< 36 - 42 mo	2	c	0			burnt		12.8	356
bt	cal	r	< 36 - 42 mo	2 3	b	0					10.6	362
bt	cal	r	> 36 - 42 mo	1 2 3	c	0		5 dm	2		41.6	362
bt	cal	r		4 5	b	0		3 dm	4		5.7	356
bt	cal	l	< 36 - 42 mo	1	b	0					5.5	358
bt	dph	l		1 2	d	0					10.2	378
bt	dph	l		1 2	b	0					10.8	358
bt	dph	l		1 2	b	0					9.7	273
bt	dph	r		1 2	c	4					4.9	356
bt	dph	r		1 2	b	0					6.6	356
bt	dph	l		1 2	d	0					3.2	352
bt	dph	r		1 2	b	0					14.4	273
bt	dph	l		1 2	b	0					13	356
bt	dph	r		1 2	c	0					6.9	383
bt	dph	r		1 2	b	0					8.5	381
bt	dph	r		1 2	b	0					10.2	356
bt	dph	r		1 2	b	0					11.9	356
bt	dph	r		1 2	b	0					10.7	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	dph	r		1 2	b	0					5.5	356
bt	dph	r		1 2	b	0					8.6	362
bt	dph	r		1 2	b	0					10.2	358
bt	dph	r		1 2	c	0					11.6	356
bt	dph	r		1 2	c	0					9.7	358
bt	dph	l		1 2	c	0					8.5	358
bt	dph	l		1 2	b	0					7.4	363
bt	dph	l		1 2	b	0					11.6	358
bt	dph	l		1	b	0					3.3	358
bt	dph	l		1 2	b	0					12.5	358
bt	dph	l		1 2	b	0					9.7	273
bt	dph	l		1 2	b	0					5.7	361
bt	dph	r		1 2	b	0					12.6	356
bt	dph	l		1	b	0					6.6	362
bt	dph	l		1 2	b	0					11.1	356
bt	dph	l		1 2	b	0					9	358
bt	dph	l		1 2	b	0					13	358
bt	dph	r		1 2	d	0					8	273
bt	ep	-		1	c	0					33.6	361
bt	ep	-			b	0					16.2	358
bt	ep	-			b	0					10.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ep	-			c	0					7.4	358
bt	ep	-			c	0					11.6	388
bt	ep	-			b	0					8.4	358
bt	fe	l	> 42 mo	1 2 3 4 5	b	0					92.3	356
bt	fe	l	> 42 mo	1 3 5	b	0					58	356
bt	fe	l	< 42 mo	2 3 5 6	b	0					34.3	381
bt	fe	r	> 42 mo	2 4 5	b	0					54.7	361
bt	fe	r			b	0					3.2	365
bt	fe	l	> 42 mo	4 5	b	0					56.2	378
bt	fe	l	> 42 mo	4	b	0					35.4	356
bt	fe	l	< 42 mo	5	b	0					9.7	356
bt	fe	l	< 42 mo	4	b	0					9.5	356
bt	fe	l		7	c	0		8 fm	7		62.2	363
bt	fe	r		7 8	b	0					24.9	273
bt	fe	l	> 42 - 48 mo	9 # @	c	0					95.2	291
bt	fe	l		7 8	b	0					44.8	381
bt	fe	l		9	c	0					7	358
bt	fe	l	< 42 - 48 mo		b	0					6.9	381
bt	fe	l		9	c	0	gn				23.8	358
bt	fe	l	< 42 - 48 mo		b	0					8.4	356
bt	fe	l	< 42 - 48 mo		b	0					7	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	fe	l			c	0					17.8	358
bt	fe	l	< 42 - 48 mo	9 # @	d	0					14.4	356
bt	fe	l	< 42 - 48 mo	9 # @	c	0					23.5	381
bt	fe	l			c	0					12.1	362
bt	fe	r		7 8	b	0		5 dm	7		75.5	273
bt	fe	l	> 42 - 48 mo	9 # @	c	0					120.8	356
bt	fe	r	< 42 mo	4	b	0					2.5	361
bt	fe	r	< 42 mo	4	b	0					12.8	383
bt	fe	r	> 42 mo	2 3 5	b	0					24.6	352
bt	fe	r	> 42 mo	4	b	0					23.6	361
bt	fe	r	> 42 mo	n	b	0					5.6	358
bt	fe	r	> 42 mo	1	b	0					55.4	356
bt	fe	r	> 42 mo	2 3 5	b	0					80.5	358
bt	fe	r	> 42 mo	1	b	0					18.8	273
bt	fe	r	< 42 mo	4	b	0					15.5	358
bt	fe	l	> 42 - 48 mo	9 # @	b	0					144.4	356
bt	fe	r			b	0					17.6	361
bt	fe	r	> 42 mo	4 5	b	0					60.8	356
bt	fe	r	< 42 - 48 mo	9	c	0					26.1	381
bt	fe	r	> 42 - 48 mo	9	b	0					27.2	361
bt	fe	r	< 42 - 48 mo	7 8	b	0		2 fm, 1 fm	7, 8		17.2	290

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	fe	r	> 42 - 48 mo	#	b	0		4 fm	8		42.8	356
bt	fe	r			b	0					25.4	358
bt	fe	r	> 42 - 48 mo	@	b	0					40.1	356
bt	fe	r	> 42 - 48 mo	#	b	0					38.7	358
bt	fe	-		2	c	0					12.5	362
bt	fe	r			b	0		4 fm	8		13.8	358
bt	fe	r		@	c	0					13 2	361
bt	fe	r			b	0					4.5	358
bt	hu	r			b	0					18.6	360
bt	hu	l	> 12 - 18 mo	3 4 5 6 7 8	d	0					84.9	362
bt	hu	l	> 12 - 18 mo	3 4 5 6 8	c	0		7 fm	8		147.6	362
bt	hu	r			c	0		6 fm	8		20.6	358
bt	hu	l	> 12 - 18 mo	7 @	b	0		4 fm	8		48.7	383
bt	hu	l	< 12 - 18 mo	7 8	c	1					17.8	362
bt	hu	l	< 12 - 18 mo	7 8	b	0		2 dm	7		19.4	356
bt	hu	l	< 12 - 18 mo	7 8 9	c	1					14.9	365
bt	hu	r	< 42 - 48 mo	@	b	0					63.8	385
bt	hu	r	18 - 42 mo	4 6	d	0					26	281
bt	hu	l		8	b	0		1 fm, 14 fm	7, 8		21	362
bt	hu	l	> 12 - 18 mo	3 4 5 6	b	0		2 dm, 4 dm	7, 8		68.6	383
bt	hu	l	< 12 - 18 mo	5 6	c	0					6.9	365

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	hu	l	> 12 - 18 mo	3 4 5 6 7 8	b	0		1 fm, 1fm	4, 7		100.2	358
bt	hu	r	< 42 - 48 mo	2	c	0					14.4	361
bt	hu	l		7	b	0		20+ fm	7		13.7	358
bt	hu	r	< 12 - 18 mo	5 6	b	0		1 fm	5		10.9	273
bt	hu	l		7 8	b	0					35.4	362
bt	hu	r			c	0					12.4	363
bt	hu	l	< 42 - 48 mo	@	b	0		4 fm	@		11.3	383
bt	hu	l			b	0					3.3	291
bt	hu	r	< 12 - 18 mo	7 8 9# @	b	0					15.9	361
bt	hu	l		2	b	0		3 fm	@		49.7	356
bt	hu	l	< 42 - 48 mo		b	0					33.5	361
bt	hu	l			b	0		9 fm	7 8		18.2	388
bt	hu	r	> 12 - 18 mo	3 4 5 6 7 8	c	0		3 fm, 7 fm	7, 8		104.7	381
bt	hu	r	< 12 - 18 mo	7	d	0					31.6	247
bt	hu	r		7 8	b	0		3 fm	7		59.9	412
bt	hu	r	> 12 - 18 mo	5	c	0					41.9	256
bt	hu	r	> 12 - 18 mo	3 4 5 6	d	0					44.1	354
bt	hu	r	> 12 - 18 mo	3 4 5 6	c	0		3 fm	7		48.3	376
bt	hu	r	> 12 - 18 mo	3 4 5 6	c	0					39.9	358
bt	hu	r	> 12 - 18 mo	3 4 5 6	c	0		5 fm	7		85.2	362
bt	hu	l	< 12 - 18 mo		b	0		2 dm	8		11.1	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	hu	r	> 12 - 18 mo	3 4 5 6	c	0					82 7	356
bt	hu	l	> 12 - 18 mo	4	d	0		1 dm	8		17.4	354
bt	hu	r	> 12 - 18 mo	3 4 5 6 7 8	c	0					106 5	358
bt	hu	r	> 12 - 18 mo	3 4 5 6 7 8	c	0		4 fm	8		112 7	358
bt	hu	r		2	b	0					15.6	362
bt	hu	r			b	0		5 fm	7		17.6	363
bt	hu	r	> 12 - 18 mo	5 6	c	4				burnt	33.8	383
bt	hu	r		3 4 5 6	b	0					83.4	356
bt	hu	r			c	0		1 fm	7		12.8	378
bt	hu	l	< 12 - 18 mo	5 6	c	0					10.4	356
bt	hu	l	> 12 - 18 mo		c	0					11.8	246
bt	hu	l		1 2	b	0		4 cm	2		105.4	356
bt	hu	r	> 12 - 18 mo	5 6	d	0					20.2	398
bt	hu	r	< 12 - 18 mo	7 8	b	0		2 fm	7		8 8	358
bt	hu	r			c	0					13.1	383
bt	mc	l		1 5	c	0					20	412
bt	mc	l		1	d	0					22.7	291
bt	mc	l			d	0					8	358
bt	mc	l		7 8	b	0					6.4	273
bt	mc	l		2	b	0		4 dm	6		5.2	358
bt	mc	l			b	0					7.2	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mc	l		2	b	0					11.2	356
bt	mc	l			c	0					5 9	356
bt	mc	l		1	b	0					7	358
bt	mc	l			b	0					3.9	358
bt	mc	l		1	c	0		8 fm	5		9.8	358
bt	mc	r	< 0		b	0					4.8	361
bt	mc	-			b	0					3.5	273
bt	mc	l		1 2	c	0		1 cm, 2 fm	6		12	375
bt	mc	l			b	0					4	356
bt	mc	r		2 6	c	0		8 fm	6		23.3	358
bt	mc	l		1 2 3 4 5 6 7 8	d	1					91.3	356
bt	mc	r		3 4	c	0					30.2	356
bt	mc	r		3 4	c	0		4 fm	7		33.5	273
bt	mc	r		3 4 7 8	c	0		1 dm	8		48.2	388
bt	mc	r		3 4	c	1					24.8	282
bt	mc	r		3 4	c	0					22.9	358
bt	mc	r		1 2	c	0		2 cm	5		9.5	356
bt	mc	r		2	d	0					11.2	352
bt	mc	r		1 2	c	0		1 cm, 2 fm	6		8.1	273
bt	mc	r	< 0	5 6	b	0					11.3	356
bt	mc	l		3 4	b	0		1 cm	4		24.6	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mc	l		1 5	c	0					16.2	358
bt	mc	r		3 4	c	0					28	356
bt	mc	l		7	c	0		2 fm	7		33 7	363
bt	mc	l		3 4	c	0					28.1	273
bt	mc	-			b	0					5	358
bt	mc	-			b	0	0	11 fm	7, 8		11.5	358
bt	mc	-		3 4	d	0		4 dm	£		19.4	358
bt	mc	r			c	0					12.6	383
bt	mc	r			b	0					11.3	358
bt	mc	r		1	b	0					5.7	361
bt	mc	r		2	b	0					4.8	356
bt	mc	r		4	c	2				Cu stain	4	361
bt	mc	r			b	0					8.5	273
bt	mc	r		8	d	0					5.6	363
bt	mc	r		3	c	1					7.7	358
bt	mc	l		1 2 3 4 5 6 7 8	d	1					98.1	358
bt	mc	l	< 0	5 6 7 8	b	0					20	361
bt	mc	l		2 6	b	1		5 fm	6		11.4	356
bt	mc	l		3 4	c	0					24.9	273
bt	mc	l		1 2 5 6	c	0		2 fm	5		25.4	358
bt	mc	r		3 4	d	0					26.7	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mc	l	< 0	5 6 7 8	b	0					20.3	356
bt	mc	l		1 2 5 6	c	2		4 fm, 8 fm	5, 6		30.9	380
bt	mc	l	< 0	5 6 7 8	b	0					20.7	358
bt	mc	l	< 0	5 6 7 8	b	0					19.6	356
bt	mc	l		3 4	b	0					22	380
bt	mc	l		5 6 7 8	d	0					85.4	358
bt	mc	l			c	0		11 fm	6		32.7	273
bt	mc	l		1 2	c	0					24.6	361
bt	mc	l		2 6	d	3					28.6	363
bt	mc	l		3 4	c	1					40.6	357
bt	mc	r		1 2	b	0					13.1	273
bt	mc	l		2 6	c	0					18.9	361
bt	mc	r		1 2 5 6	d	0					52.2	273
bt	mc	r	< 0	5 6	b	0					10.7	273
bt	mc	r		1 2	b	0					30.4	358
bt	mc	r		1 2	c	1		5 dm, 7 fm	5, 6		23.7	383
bt	mc	r		1 2	d	0					17.8	291
bt	mc	r		1 2	c	0		5 fm	5		21.6	361
bt	mc	r	< 0	5 6 7 8	b	0					19.3	356
bt	mc	r		1 2	c	0		3 fm	8		46.1	358
bt	mc	r		1 2	c	1					30.8	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mc	r		1 2 5 6	c	1		6 dm, 7 fm	1, 5	burnt	68	363
bt	mp	-		$	d	0					4.7	362
bt	mph	r		1 2 3	b	0					10.2	358
bt	mph	r		1 2 3	b	0					10.9	273
bt	mph	r		1 2 3	b	0					11.4	358
bt	mph	r		1 2 3	b	0		4 dm	3		10.5	273
bt	mph	r		2 3	b	0					3.7	282
bt	mph	r		1 2 3	c	0					7.1	282
bt	mph	r		1 2 3	d	0					6.9	290
bt	mph	r		1 2 3	c	3		1 dm	3	burnt	6.9	291
bt	mph	r		1 2 3	b	0					9.3	358
bt	mph	r		1 2 3	b	0					5.1	380
bt	mph	r		1 2 3	b	0					6.8	358
bt	mph	r		1 3	b	0		1 cm	3		7	381
bt	mph	r		1 2 3	b	0					9.3	358
bt	mph	r		1 2 3	b	0					12.2	356
bt	mph	r		1 2 3	b	0		2 dm	3		10.1	358
bt	mph	r		1 2 3	c	3				burnt	8.6	367
bt	mph	r		1 2 3	c	0					7	358
bt	mph	r		1 2 3	b	0		2 dm	3		12.3	356
bt	mph	r		1 2 3	b	0					10.2	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mph	r		1 2 3	b	0					9.6	361
bt	mph	r		1 2 3	c	0					5 6	362
bt	mph	r			c	1				burnt	2.9	273
bt	mph	r		2	b	0					1.1	281
bt	mph	r		1 2 3	b	0					12.4	358
bt	mph	l		1 2 3	c	0		1 dm	3		4.4	361
bt	mph	l		1 2 3	c	0					8	358
bt	mph	l		1 2 3	c	0					5.8	281
bt	mph	l		1 2 3	c	0					10	356
bt	mph	l		1 2 3	c	0					8.5	291
bt	mph	l		1 2 3	b	0					10.8	358
bt	mph	l		1 2 3	b	1					11.4	383
bt	mph	l		1 2 3	c	0					6.6	358
bt	mph	l		1 2 3	c	0					9.6	358
bt	mph	l		1 2 3	c	0					6.9	358
bt	mph	r			c	0					2.2	273
bt	mph	l		1 2 3	b	0		2 dm	3		7.3	358
bt	mph	r		2 3	c	1				burnt	3.1	381
bt	mph	l		1 2 3	c	1					7.1	367
bt	mph	l		1 2 3	d	0					6.5	246
bt	mph	l		2 3	c	0					6.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mph	l		2 3	c	0					4.8	273
bt	mph	l		2 3	c	0				punc	2.7	273
bt	mph	l		2 3	c	0					3.5	356
bt	mph	l		1	d	0					2	361
bt	mph	l			c	0					1.2	361
bt	mph	l		1 2 3	c	0					7.5	373
bt	mph	r		1	b	0					1.7	273
bt	mph	l		1 2 3	c	4					13.3	381
bt	mph	r		1	b	0					2.1	273
bt	mph	r		2 3	c	0					5.3	273
bt	mph	r		1	b	0					0.9	358
bt	mph	r		2 3	c	0					2.1	358
bt	mph	r		2 3	d	0					4.6	356
bt	mph	r		1	c	0					0.8	273
bt	mph	r		2 3	b	0					1	356
bt	mph	r		2 3	b	0					0.8	358
bt	mph	l		1 2 3	b	0					11.9	356
bt	mph	l		1 2 3	b	0					12.5	375
bt	mph	r		2 3	b	0					4.3	358
bt	mph	l		1 2 3	c	0					10.5	381
bt	mph	l		1 2 3	c	0					5.3	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mph	l		1 2 3	b	0		1 dm	3		8.7	362
bt	mph	l		1 2 3	c	0		2 dm			7.1	362
bt	mph	l		1 2 3	b	0					7.3	358
bt	mph	l		1 2 3	b	0					9	356
bt	mph	l		1 2 3	b	0					8 8	381
bt	mt	l			b	0					7	362
bt	mt	l		1	b	0					7.7	358
bt	mt	l		1	b	0					4.4	354
bt	mt	l		1	b	0					5.2	354
bt	mt	l		7	b	0		4 fm	7		5.2	378
bt	mt	l		3	c	0					7	358
bt	mt	l		4	c	0					10.4	273
bt	mt	l		3	b	0					17.5	358
bt	mt	l			c	0		7 fm	6		11.8	361
bt	mt	r			c	0		2 km	6		9.1	358
bt	mt	l		3 4	c	0		25 dm, 5 dm	3, 7		19.8	362
bt	mt	l			c	1		1 fm	7		14.1	358
bt	mt	r			b	0					35.6	378
bt	mt	l		3	c	0					3.9	381
bt	mt	l		2	c	0		2 dm	5 - 6		13.4	378
bt	mt	-			d	0					6.6	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mt	l			c	0					11.3	361
bt	mt	l		1 2	c	0		1 fm, 3 fm	5, 6		6.3	381
bt	mt	r			c	0					6	358
bt	mt	l		7 8	b	0					4.5	383
bt	mt	-		£	c	0	gn				6.5	247
bt	mt	-			b	0					3.6	273
bt	mt	r		1	b	0					3.6	358
bt	mt	l			d	0					9.9	358
bt	mt	r		3 4	c	0					22.1	361
bt	mt	l		2	c	0		4 km	6		14.5	361
bt	mt	r		3	d	0					2.2	356
bt	mt	-			b	0		2 km	£		3.6	358
bt	mt	l		3	b	0					6.4	356
bt	mt	-			c	0					4	358
bt	mt	l			c	1		7 km	7		11.6	358
bt	mt	l			c	0					14.8	358
bt	mt	-			d	0					17.6	362
bt	mt	-			b	0		7 cm	5 - 6		7.4	361
bt	mt	l		7	c	0					7	380
bt	mt	l		4	b	0					6.5	356
bt	mt	l		7 8	c	0		1 ? Fm	7-8	neonat	7.5	273

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mt	r		1 2 6	c	0		29 dm	5		33 3	358
bt	mt	r		3	b	0					4.5	358
bt	mt	r		3	b	0					8 2	358
bt	mt	r		4	b	0					3.6	357
bt	mt	r		3	b	4				burnt	5 9	356
bt	mt	r		4	b	0					4	381
bt	mt	r		4	b	0					4.3	378
bt	mt	r		3	b	0					6.7	356
bt	mt	r		1	b	0		8 fm	6		11.2	358
bt	mt	r		1 2	b	0					9.1	273
bt	mt	r			b	0					4.3	358
bt	mt	r		5 6 7 8	c	0		1 fm, 14 fm	5, 6		11.2	358
bt	mt	r		3 4	d	0					24.5	352
bt	mt	l		3 4	c	0		5 dm	8		30.5	358
bt	mt	r		3 4 7 8	c	0					40.4	356
bt	mt	r		7 8	c	0		2 fm, 1 fm 7, 8			9.3	380
bt	mt	r		1 2 5 6	c	1		2 cm	6		44.2	358
bt	mt	r		1 2 5 6	d	0					14.5	358
bt	mt	r		3 4 7 8	c	0		2 cm	7		38.2	356
bt	mt	r		1 2 5 6 7 8	d	0					65.4	358
bt	mt	r		1 2 5 6 7 8	c	1					89.7	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mt	r		3 4 7 8	b	0					30 9	360
bt	mt	r		1 2	b	0		5 dm	1		15.7	358
bt	mt	l		3 4	b	0					57.3	381
bt	mt	r		5 6 7 8	b	0					18.7	356
bt	mt	r			b	0					9.1	358
bt	mt	l		1 2	c	0		7 fm, 5 fm	5, 6		47.9	356
bt	mt	l		1 2	c	0		7 fm	6		40.1	273
bt	mt	l		1 2 5 6	c	0					48.9	291
bt	mt	l		3 4 7 8	d	0					44.3	365
bt	mt	l		5 6 7 8	b	0					21.6	356
bt	mt	l		1 2 5 6 7 8	c	0		19 km, 15 km, 2 fm, 4 fm	5, 6, 7, 8		77.2	273
bt	mt	-			c	1					2.1	362
bt	mt	-			b	0					4.5	358
bt	mt	-			c	0		4 fm			18.1	361
bt	mt	-		£	c	0					9.9	358
bt	mt	-		$	d	0		2 dm	£		10.7	362
bt	mt	-		$	d	0					6.9	362
bt	mt	-			c	0					8	358
bt	mt	r			d	0					9	358
bt	mt	r			b	0					9.6	362
bt	mt	r			c	0					2.3	364

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	mt	l		1 2	d	0		2 dm	6		36.6	0
bt	mt	r			c	0					4.2	356
bt	pe	l	> 7 - 10 mo	1	b	0					3	356
bt	pe	l	> 7 - 10 mo	3	b	0					14.8	273
bt	pe	l	> 7 - 10 mo	3	b	0					10.6	273
bt	pe	l	< 7 - 10 mo	1 5	b	0					9.3	273
bt	pe	l	> 7 - 10 mo	1	b	0					9.2	358
bt	pe	l	> 7 - 10 mo	1 5	c	0					32.4	380
bt	pe	r	< 7 - 10 mo	3 8	c	0		1 cm	8		7.6	356
bt	pe	r	> 7 - 10 mo	3 8	b	0					14.3	356
bt	pe	l	< 7 - 10 mo	3 8	b	0					11.6	356
bt	pe	l		2 4	b	1		2 km, 1 km	2, 6		34.5	358
bt	pe	l	< 7 - 10 mo	2	c	0					6.4	273
bt	pe	l	> 7 - 10 mo	2	c	0		2 km	1		14	354
bt	pe	r		3 8	b	0					4.8	367
bt	pe	l	> 7 - 10 mo	2	b	0					4.3	412
bt	pe	r	> 7 - 10 mo	3 8	b	0					15.2	290
bt	pe	r	> 7 - 10 mo	2	c	0					15.3	358
bt	pe	r	> 7 - 10 mo	1 5	b	0					76.4	273
bt	pe	r	> 7 - 10 mo	2	c	0					9.3	356
bt	pe	l		2	c	0					4.8	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pe	l	< 7 - 10 mo	2 6 @	b	0					6.8	358
bt	pe	l	> 7 - 10 mo	2 6	c	0		1 cm, 2 fm	2, 6		17.5	378
bt	pe	l	> 7 - 10 mo	2	c	2					9.2	351
bt	pe	r	> 7 - 10 mo	2	c	0					23.5	273
bt	pe	r		2 6	c	1					10.3	381
bt	pe	r		1 5 7 #	c	0					13.7	383
bt	pe	l		2 6	c	0					6	378
bt	pe	l		2 6	c	0					6.6	358
bt	pe	l		3 8	c	0					7.9	378
bt	pe	l			b	0					2	358
bt	pe	r	> 7 - 10 mo	2	c	0					14.1	363
bt	pe	r	> 7 - 10 mo	2	b	0					8.5	273
bt	pe	r	< 7 - 10 mo	1	c	0		10 km	5		21.7	356
bt	pe	r	> 7 - 10 mo	2	c	0					14.7	361
bt	pe	r	> 7 - 10 mo	3 8	c	0					15.9	363
bt	pe	r	> 7 - 10 mo	2	c	0					31.6	358
bt	pe	r	> 7 - 10 mo	1	d	0					25.8	356
bt	pe	r	> 7 - 10 mo	1	c	0					18.4	378
bt	pe	r	> 7 - 10 mo	1	c	0		5 km	5		49.8	358
bt	pe	r	< 7 - 10 mo	1 5 7 #	b	1				burnt	13.9	357
bt	pe	r	< 7 - 10 mo	1 5 7 #	c	0					8.8	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pe	r	< 7 - 10 mo	1 5 7 #	c	0		1 fm	#		11.7	358
bt	pe	r	> 7 - 10 mo	3 8	b	0					16.9	358
bt	pe	r	> 7 - 10 mo	3 8	b	0					12.5	358
bt	pe	r	> 7 - 10 mo	2	b	0					19.8	273
bt	pph	l		2 3	b	0		4 dm	3		3 9	356
bt	pph	r		1 3	b	0					12.2	291
bt	pph	r		2 3	b	0					3.5	273
bt	pph	r		1 2 3	b	0					17.5	356
bt	pph	r		1 2 3	c	0					14.6	356
bt	pph	r		1 2 3	b	0					16.4	361
bt	pph	r		1 2 3	b	0					19.5	358
bt	pph	r		1 2 3	c	0		5 dm	3		13.5	358
bt	pph	r		1 2 3	c	0					12	363
bt	pph	r		1	c	0					5.8	380
bt	pph	r		1 2 3	c	0					17.9	356
bt	pph	r		2 3	c	0					9	383
bt	pph	r		1 2 3	d	0					6.3	354
bt	pph	r		1 2	d	0					4.8	383
bt	pph	r		1 2 3	d	0					6.6	361
bt	pph	r			c	0					4.7	412
bt	pph	l		2 3	d	0					5.9	281

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pph	r		1 3	b	0					7.4	361
bt	pph	r		1 2 3	c	0					18.1	280
bt	pph	l			c	0					2 8	356
bt	pph	l		2 3	b	0					3.5	273
bt	pph	l		2 3	b	0					3	273
bt	pph	l		2 3	b	0					2.9	362
bt	pph	l		1	b	0					3	273
bt	pph	l		1	b	0					3.6	358
bt	pph	r		1 2 3	c	0					15.2	356
bt	pph	l		1	c	0					2.6	246
bt	pph	r		2 3	b	0					6	273
bt	pph	r		1 2 3	c	0					10.2	354
bt	pph	r		1 2 3	c	0					12.2	358
bt	pph	r		1 2 3	c	0					15.9	362
bt	pph	r		1 2 3	c	1					14.3	356
bt	pph	r		1 2 3	c	0					13.8	362
bt	pph	r		1 2 3	c	0		8 dm	3		17.6	358
bt	pph	l		1	d	0					3.9	273
bt	pph	r		2 3	c	0					3.7	358
bt	pph	r		2 3	c	0					3.1	383
bt	pph	l		2 3	b	0					2.1	381

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pph	l		2 3	b	0					1 6	358
bt	pph	l		2 3	b	0					2	358
bt	pph	r		2 3	c	0					7.9	381
bt	pph	r		2 3	c	0					7.5	358
bt	pph	l		2	c	0					2 7	356
bt	pph	r		3	c	0					2 5	246
bt	pph	l		2	c	0					1 4	361
bt	pph	r		2 3	b	0					2.8	356
bt	pph	l		2 3	c	0					10.6	375
bt	pph	r		2 3	c	0					3.3	362
bt	pph	r		2 3	b	0					2.1	356
bt	pph	r			b	0					2.2	362
bt	pph	r		2	c	0		3 dm	3		5 1	361
bt	pph	r			c	0					3.4	291
bt	pph	r		1	b	0					2.3	356
bt	pph	r		2 3	b	0					6.8	273
bt	pph	r		1	b	0					2.7	273
bt	pph	r		1	b	0					2.1	332
bt	pph	r		1	b	0					3.3	358
bt	pph	r		1	c	0					1.3	273
bt	pph	r		1	c	0					2 4	273

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pph	l		2 3	c	0		1 dm	3		3.6	362
bt	pph	r		2 3	b	0					6	356
bt	pph	r		3	c	0					3.3	291
bt	pph	r		1	b	0					6.6	356
bt	pph	r		1	b	0					6	362
bt	pph	r		1 3	c	1					8.9	362
bt	pph	r		2 3	c	0					2.3	356
bt	pph	l			c	0					4.2	273
bt	pph	l		2	c	0					5.6	362
bt	pph	r		1	c	0					1.4	356
bt	pph	l		1 2 3	d	0					12.2	361
bt	pph	l		1	c	0					4.6	383
bt	pph	l		1 2 3	c	0					14.3	358
bt	pph	l		1 2 3	b	0					19	356
bt	pph	l		1 2 3	c	0					15.3	363
bt	pph	l		1 2 3	c	0				path wearing of artic sf	19.4	358
bt	pph	r		2 3	c	0					2.1	291
bt	pph	l		1 2 3	c	0		5 dm	3		15.5	358
bt	pph	l		2 3	c	0					15.6	273
bt	pph	l		1 2 3	c	0					13.6	273
bt	pph	l		1 3	c	0					10.2	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	pph	l		1	c	0			1	3	6.1	375
bt	pph	l		1 3	c	0		6 dm, 4 dm	1, 3		12 1	356
bt	pph	l		1	d	0					5.9	361
bt	pph	l		1	c	0					5.2	356
bt	pph	l		1	b	0				path striations on artic s	7.7	358
bt	pph	l		1	c	0					8.1	358
bt	pph	l		1 2 3	c	0					20.6	381
bt	ra	r		9	b	0					7.3	273
bt	ra	l		4	c	0				burnt	11.8	354
bt	ra	l			c	0		2 km	5		7.1	383
bt	ra	l	< 12 - 18 mo	1 2	c	0					4.8	273
bt	ra	l	< 42 - 48 mo	9 #	c	0					33.6	358
bt	ra	l	< 12 - 18 mo	5	b	0		2 fm	5		7.7	358
bt	ra	r			b	0					5.6	356
bt	ra	l			c	0					5.3	362
bt	ra	r		6	b	0					15.5	291
bt	ra	l		1	b	0					9.2	361
bt	ra	r		6	b	0				??Pattern?	25.8	356
bt	ra	r		2	c	0					18.8	373
bt	ra	l			b	0		20 fm	5		13.9	358
bt	ra	l	< 12 - 18 mo	6 7 8 9 #	b	0		7 fm	6		35.8	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ra	r		1 2 5	c	0					40.2	362
bt	ra	r		1 2	b	0		5 fm	5		13.2	383
bt	ra	r		1 2	c	0					14.5	358
bt	ra	r		2	b	0					21.3	358
bt	ra	r		1	c	0					36	358
bt	ra	r		1 2 5	c	0		1 cm, 2 fm	5		29.6	281
bt	ra	l			d	0	gn				33.1	412
bt	ra	l		1 2 5	b	0		1 dm, 54 km	5		64.3	383
bt	ra	r	> 12 - 18 mo	3 4 9 # J H	c	0					44.9	358
bt	ra	r		1	c	4				burnt	13.5	273
bt	ra	r		1 2	c	0		3 dm, 5 dm	1, 2		40.5	356
bt	ra	r		1 2 5 6 7	c	0					45.7	358
bt	ra	r	> 12 - 18 mo	3 9 J	c	0					13.6	365
bt	ra	r	< 42 - 48 mo	3 4	d	0					10.5	352
bt	ra	r	< 42 - 48 mo	3 4	c	0					21.2	358
bt	ra	r		1 2 5	c	0					24.5	361
bt	ra	r	> 12 - 18 mo	3	c	0					8.8	281
bt	ra	l		1 2	c	0					16.4	373
bt	ra	l		1	b	1					13.9	367
bt	ra	l		1 2	b	0		2 ? Km	5		26.1	358
bt	ra	l		1 2	b	0					22.7	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ra	l		1 2 5	b	0					48.1	383
bt	ra	l	> 12 - 18 mo	3 4 9 # J	c	0					40.2	362
bt	ra	r		1 2 5	b	0					31.5	356
bt	ra	l		2	b	0					11.7	356
bt	ra	r	> 12 - 18 mo	3 4 6 7 8 9 # J G H	c	0					108.1	362
bt	ra	r			b	0					12.4	358
bt	ra	r		1 2 5	b	0					36.1	362
bt	ra	l	< 42 - 48 mo	6 7 8 9 #	c	0					15.1	381
bt	ra	r	> 12 - 18 mo	3 4 8 9 # J H	c	0		3 cm	#		57	381
bt	ra	l	< 42 - 48 mo	6 7 8 9 #	c	2					10.3	356
bt	ra	r			b	1		6 fm	7		11.9	362
bt	ra	l	< 12 - 18 mo	4	c	0					5	356
bt	ra	r	< 12 - 18 mo	5 6 7	b	0					17.2	356
bt	ra	r	< 12 - 18 mo	5 6 7	b	0					26.6	358
bt	ra	r	< 12 - 18 mo	1 2	c	0					7.9	383
bt	ra	r	< 12 - 18 mo	5 6 7 8 9 #	b	0					22.7	358
bt	ra	r	< 12 - 18 mo	5 6 7 8 9 #	b	0					17.3	383
bt	ra	r			c	0				burnt	12.4	356
bt	ra	l		2	c	1					21.6	282
bt	ra	r		1	b	0					13.9	291
bt	ra	l			c	0					12.6	367

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ra	r		6	b	0					6	358
bt	ra	l		6 F	b	0					15.6	358
bt	ra	l			b	0		3 cm, 11 fm			17 7	291
bt	ra	l			b	0					6.7	358
bt	ra	l			b	0					5.1	361
bt	ra	r	< 12 - 18 mo	5 6 7 8 9 #	b	1					36.9	385
bt	sc	l	< 6 mo	1 2 3 4 5 7	b	0					16.1	356
bt	sc	l	> 6 mo	1 2 3	b	0					43.1	357
bt	sc	r	> 6 mo	1 2 3	c	1					19.5	380
bt	sc	l	< 6 mo	1 2 3 4 5	b	1		5 fm	3		22.7	356
bt	sc	l	> 6 mo	1 2 3 5 7	b	0					84.6	428
bt	sc	l	> 6 mo	1 2 3 4 5	c	0		1 cm	4-5		62.8	375
bt	sc	l	> 6 mo	1 2 3 4 5 7	b	0		10 fm	4		46.3	356
bt	sc	l	> 6 mo	1 2 3 5	b	0					68.8	362
bt	sc	l	> 6 mo	1 2 3 4 5 6 7	b	1					54.1	358
bt	sc	l	> 6 mo	1 2 3	b	0					36.1	381
bt	sc	r	> 6 mo	1 2 3 4 5 6 7	c	0		7fm, 2fm	7, 9		96.6	356
bt	sc	l	> 6 mo	1 2 3	c	0					20.5	373
bt	sc	r	> 6 mo	1 2 3	d	0					7.5	354
bt	sc	r	> 6 mo	1 2 3	b	0		3 fm	3		40.9	273
bt	sc	r	< 6 mo	2 3 4 5	b	0					21.7	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	sc	l	> 6 mo	1 2 3 4 5	b	1		15 fm	2		55.2	378
bt	sc	r	> 6 mo	1 2 3 4	b	0		18 fm	4		35.3	361
bt	sc	r	< 6 mo		c	0					2.2	362
bt	sc	r	> 6 mo	1 2 3	b	0					27.4	358
bt	sc	r	> 6 mo	1 2 3	b	0		1 cm	3		27	361
bt	sc	r	> 6 mo	1 2 3	b	0					31.4	358
bt	sc	r	< 6 mo	1 4	b	0		1 fm	3		12.2	358
bt	sc	r	< 6 mo	1 2 3 4 5	b	0		1 fm	5		13.9	361
bt	sc	r	< 6 mo	1 2 3 4 5	c	0					11.8	356
bt	sc	r	< 6 mo	1 2 3 4 5	d	0					15.8	273
bt	sc	r	< 6 mo		b	0					3.4	356
bt	tb	r		#	c	0					17.4	363
bt	tb	l			b	0					5	358
bt	tb	l			b	4				burnt	7.7	356
bt	tb	l		#	d	0		5 fm	#		59.8	388
bt	tb	l	< 24 - 30 mo	5 6	b	0				neonat	1.6	358
bt	tb	l		9	c	0		5 fm	9		19	358
bt	tb	r			c	0					15.5	362
bt	tb	r	< 42 - 48 mo	7 8 9 #	b	1		1 fm	8		25.6	356
bt	tb	r	< 42 - 48 mo	1 2 3	c	0					6.9	361
bt	tb	l	> 24 - 30 mo	5 6 #	c	0					54.3	388

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	tb	r	> 24 - 30 mo	5 6 9 #	c	0		8 fm, 9 fm	7, 8		96.8	383
bt	tb	r			c	3				burnt	6.5	367
bt	tb	l			c	0		2 dm, 1 fm	7		16.5	362
bt	tb	l	< 42 - 48 mo	3	b	0					11.1	381
bt	tb	l	> 42 - 48 mo	1	b	0		1 dm	1		15.8	378
bt	tb	l	< 42 - 48 mo	1 2 3 4	b	0					9.2	356
bt	tb	l	> 42 - 48 mo	2 7	c	0					42.6	246
bt	tb	l	> 42 - 48 mo	1 2 3 4 7	b	0					94.6	362
bt	tb	r			d	0					5.8	354
bt	tb	r	< 42 - 48 mo		c	0					6.8	358
bt	tb	r	< 42 - 48 mo	4	b	0					14.2	361
bt	tb	r	> 24 - 30 mo	5 6 #	c	0		5 fm	#		37.1	358
bt	tb	r	< 42 - 48 mo		d	0					3.1	358
bt	tb	r	> 24 - 30 mo	5 6 9 #	c	1		1 fm	#		76.5	352
bt	tb	r	< 42 - 48 mo	1 2 3	c	0					4.8	273
bt	tb	r	< 42 - 48 mo	1 2 3	c	0					4.8	356
bt	tb	r	< 42 - 48 mo	1	b	0					7.5	273
bt	tb	r	< 42 - 48 mo	1 2 3 4	b	0		2 dm	2		17.3	356
bt	tb	r	> 42 - 48 mo	1 4	b	0					30.5	356
bt	tb	r	> 42 - 48 mo	1 2 3 4	c	0					57.6	361
bt	tb	r	> 42 - 48 mo		d	0					13.4	291

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	tb	r	< 42 - 48 mo		b	0					8.4	273
bt	tb	l			b	0					13.4	383
bt	tb	r			c	0					16.3	362
bt	tb	r	< 42 - 48 mo	7	b	0		3 odd marks / holes	7		164.4	373
bt	tb	r	< 42 - 48 mo	1 2 3 4	c	0		1 dm	1		37.6	358
bt	tb	r	> 42 - 48 mo	1 2 3 4	c	0		7 fm	7		87.8	361
bt	tb	r	< 42 - 48 mo		b	0		2 fm	7		13.1	356
bt	tb	l	< 24 - 30 mo	5 6	c	0					2.5	361
bt	tb	l			b	0					4.9	273
bt	tb	l			b	0		2 fm	7		12.8	358
bt	tb	l			c	0					2.7	362
bt	tb	l	< 24 - 36 mo	5 6	b	0					9.5	361
bt	tb	l	> 24 - 30 mo	5 6	c	0					23.9	388
bt	tb	l	> 24 - 30 mo	5 6 #	c	0		10 fm, > 30 fm	9, #		117.5	412
bt	tb	l			b	0					10.3	362
bt	tb	r	> 24 - 30 mo	5 6 7	b	0		3 fm, 12 fm	9, #		82.2	356
bt	tb	l	< 42 - 48 mo		b	0		1dm	7		15.2	356
bt	tb	l	< 24 - 36mo	#	b	0					34.9	362
bt	tb	r	< 24 - 30 mo	5 6	b	0					8.3	273
bt	tb	r	> 24 - 30 mo	5 6	c	0		1 cm	#		50.1	356
bt	tb	r	> 24 - 30 mo	5 6	c	0					22	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	tb	l	< 24 - 36mo	5 6	b	0					11.5	362
bt	tb	r	< 24 - 30 mo		b	0		2 fm	#		8.2	273
bt	tb	r	< 42 - 48 mo	7 8 9 #	b	0					31.3	356
bt	tb	r	> 24 - 30 mo	5	d	0		1 fm	#		6.1	361
bt	tb	r	< 42 - 48 mo	5	c	0					3.1	358
bt	tb	r	> 24 - 30 mo		b	0					3	361
bt	tb	r	> 24 - 30 mo	5	c	0					4.9	380
bt	tb	r			d	0		ct	7		30.4	361
bt	tb	r	> 24 - 30 mo	5 6	c	0					34.4	361
bt	ul	r	> 42 - 48 mo	A B	b	0					10.5	358
bt	ul	r			b	4				burnt	11.2	356
bt	ul	r	> 42 - 48 mo	A	b	0					11.1	358
bt	ul	r	> 42 - 48 mo	C D	b	0					27.3	358
bt	ul	r	< 42 - 48 mo	B C D	c	0					27.7	356
bt	ul	r	> 42 - 48 mo		b	1					17.2	273
bt	ul	r		E	b	0				neonat	3.8	381
bt	ul	r			c	0					5.7	291
bt	ul	l	< 42 - 48 mo	B C D E	b	0					22.8	356
bt	ul	r		E	c	0					2.5	358
bt	ul	l	< 42 - 48 mo	B C D E	b	0					6.2	356
bt	ul	r	> 42 - 48 mo	A B C	c	0					40.8	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ul	r	< 42 - 48 mo	B C D E F	b	0					7.9	273
bt	ul	l		D	c	0					3.8	358
bt	ul	l	< 42 - 48 mo	A	b	0					5.3	358
bt	ul	l	< 42 - 48 mo	A	b	0					5.5	356
bt	ul	l	< 42 - 48 mo	A	b	0					7.8	362
bt	ul	l	< 42 - 48 mo	A	c	0					6.8	291
bt	ul	l		D E	b	0		2 cm, 3 cm	C, E,		6.9	358
bt	ul	l		D	b	0					3.2	375
bt	ul	l	< 42 - 48 mo	B C D E	c	0				neonat	9.4	356
bt	ul	l	< 42 - 48 mo	B C D E	b	0				neonat	6.2	358
bt	ul	r		C D	b	0			2 fm	C	15	362
bt	ul	r		D	b	0					20.6	358
bt	ul	r		D	b	0					10.5	362
bt	ul	r		D	c	0					4	291
bt	ul	l		C D E	b	0					9.3	356
bt	ul	l	< 42 - 48 mo	B C D E	b	0				neonat	5.6	358
bt	ul	r			b	0					7.1	273
bt	ul	l	> 42 - 48 mo	A B C	b	1					26.8	358
bt	ul	l		B	c	2				burnt	14.6	363
bt	ul	l	< 12 - 18 mo	B C D E F	b	0					20.6	356
bt	ul	l	< 42 - 48 mo	B C D E	b	0					25.3	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
bt	ul	l	< 42 - 48 mo	B C D E	b	1				? Burnt	19.1	356
bt	ul	l	< 42 - 48 mo	B C D E	b	0				neonat	7	356
bt?	pph	l		1	c	0					1 9	281
ce	as	r		3 4	c	0					10.9	291
ce	as	r		1 2 3 4	c	0					8.2	354
ce	as	r		1 2 3 4	c	0					13.4	291
ce	as	r		1 2 3 4	b	0					15.3	358
ce	as	r		1 2 3 4	c	0					7.7	273
ce	as	r		1 2 3 4	c	0					5.4	291
ce	as	r		1 2 3 4	c	0					7.4	354
ce	as	r		1 2 3 4	c	4				burnt	17	356
ce	as	r		1 2 3 4	c	0					14.6	273
ce	as	r		1 2 3 4	c	0					9.8	373
ce	as	r		1 2 3 4	d	0					9.6	358
ce	as	r		1 2 3 4	d	1					12.3	356
ce	as	r		1 2 3 4	c	0		3 dm	4		9.5	291
ce	as	r		1 2 3 4	c	0					15.3	362
ce	as	r		1 2 3 4	c	0					11.2	246
ce	as	r		1 2 3 4	d	0					11.5	356
ce	as	r		1 2 3 4	c	0					7.7	381
ce	as	r		1 2 3 4	d	0					5.5	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	as	r		1 2 3 4	c	0		4 dm	4		12	281
ce	as	r		1 2 3	d	0					5.7	246
ce	as	r		1 2 3 4	d	0					8.9	378
ce	as	r		1 2 3 4	d	0					3.1	365
ce	as	r		1 2 3 4	d	0					4.7	352
ce	as	r		1 2	d	0					2.6	363
ce	as	r		1 2 3 4	d	0					10.3	363
ce	as	l		1 2 3 4	c	1					12.8	291
ce	as	r		1 2 3 4	c	0					19	363
ce	as	l		1 2 3 4	d	0					16.3	378
ce	as	l		1 2 3 4	c	0		2 dm	4		12.7	378
ce	as	l		1 2 3 4	d	2					13.7	291
ce	as	l		1 2 3 4	d	0					6.6	380
ce	as	l		1 2 3 4	c	0					11	373
ce	as	l		1 2 3 4	b	3				burnt	19	273
ce	as	l		1 2 3 4	b	0					13.2	273
ce	as	l		1 2 3 4	b	0					7.6	358
ce	as	l		1 2 3 4	c	0					10.4	356
ce	as	l		1 2 3 4	b	0		2 dm, 2 dm	1, 3		12.2	356
ce	as	l		1 2 4	b	0					10	361
ce	as	r		1 2 3 4	c	0					8.8	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	as	l		1 2 3 4	d	0					17.8	362
ce	as	l		1 2 3 4	d	0					6.8	378
ce	as	l		1 2 3 4	b	0					18.3	388
ce	as	l		1 2 3 4	d	0					31.4	363
ce	as	l		1 2 3 4	d	1					7.3	365
ce	as	l		1 2 3 4	c	0					8.8	358
ce	as	l		1 2 3 4	c	0					11.2	273
ce	as	l		1 2	d	0					4.1	352
ce	as	l		1 2 3 4	c	0					17.3	375
ce	as	l		1 2 3 4	d	0					7.3	282
ce	as	l		1 2 3 4	d	0					3.5	291
ce	as	l		1 2 3 4	d	0					6.5	378
ce	as	l		1 2	d	0					1.4	354
ce	as	l		1 2 3 4	c	0					11.2	358
ce	as	r			b	3					1	381
ce	as	l		1 2 3 4	b	0					22.7	357
ce	as	l		4	c	0					2.2	360
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					22.8	378
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					19.2	358
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					29.9	356
ce	cal	l	> 3 - 4 yrs		b	0					9.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	cal	l	< 3 - 4 yrs	1	b	0					1.2	358
ce	cal	l		4 5	b	0					2.8	273
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	c	0					18.2	358
ce	cal	l	< 3 - 4 yrs	2 3 4 5	b	0					16.5	362
ce	cal	r	> 3 - 4 yrs	1	c	0					8.2	354
ce	cal	l		2	c	0					10.6	363
ce	cal	l	< 3 - 4 yrs	2 3 4 5	c	0		1 dm	4		12.4	361
ce	cal	l		2 3 4 5	d	0					9	363
ce	cal	l	< 3 - 4 yrs	2 3	c	0		2 dm	3		7.3	356
ce	cal	l	< 3 - 4 yrs	2 3 4	b	0					15.5	273
ce	cal	l	< 3 - 4 yrs	2 3	d	0					9.4	380
ce	cal	l		2	b	0					7.3	361
ce	cal	l	> 3 - 4 yrs	1 2 3	c	0		2 dm	2		15.1	380
ce	cal	r	> 3 - 4 yrs	1	b	0					4.9	361
ce	cal	r		2 3	c	0					15.7	246
ce	cal	l		4 5	b	1					4.3	378
ce	cal	l		4 5	b	0					4	381
ce	cal	l		3	d	1					6.2	354
ce	cal	l		2 3	c	0					9.1	365
ce	cal	r	> 3 - 4 yrs	1 2 3	d	0					12.2	246
ce	cal	l	< 3 - 4 yrs	1	b	0				bluish calcitic deposit	4.2	381

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	cal	l	> 3 - 4 yrs	1 2 4	d	0					9	362
ce	cal	l	> 3 - 4 yrs	1 2 3 4 5	c	0					20.6	365
ce	cal	l	> 3 - 4 yrs	1 2 3 4 5	b	0					25.7	383
ce	cal	r		3	c	0					6.4	291
ce	cal	r		3 4 5	b	0					6	273
ce	cal	r		2 4 5	b	0					13.1	358
ce	cal	l	< 3 - 4 yrs	2 3	c	0				bluish calcitic deposit	25.1	381
ce	cal	r	> 3 - 4 yrs	1 2	d	1				no flaked off	13	0
ce	cal	l	> 3 - 4 yrs	1 2 3	d	0					11.4	354
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					21.1	356
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0		1 dm, 1 dm	2, 3		19.6	273
ce	cal	l	> 3 - 4 yrs	1 2 3 4 5	b	0					17.9	358
ce	cal	l	< 3 - 4 yrs	2 3 4 5	b	0		2 dm	2		13.5	358
ce	cal	r	< 3 - 4 yrs	2 3 4 5	c	1		3 dm	2		24.2	273
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					23	356
ce	cal	r	> 3 - 4 yrs	1 2 3 4 5	b	0					27.1	356
ce	cal	r	< 3 - 4 yrs	2 3 4 5	b	0					6.8	358
ce	cal	r	< 3 - 4 yrs	1	b	0					1.1	381
ce	cal	l	< 3 - 4 yrs	2 3 4 5	c	0		3 dm	4		23.7	358
ce	cal	l	< 3 - 4 yrs	1	c	0					2.7	358
ce	cal	l	> 3 - 4 yrs	1 2 3 4 5	b	0					23.3	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	cal	r			c	0	gn				3.3	383
ce	dph	l		1 2	c	1					4.3	273
ce	dph	l		1 2	b	0					2.8	356
ce	dph	l		1 2	b	0					3.3	380
ce	dph	l		1 2	c	0					2.8	380
ce	dph	l		1 2	b	0					2.9	358
ce	dph	l		1 2	b	0					3	361
ce	dph	r		1 2	d	0					2.2	354
ce	dph	l		1 2	b	0				neonatal	1.1	358
ce	dph	l		1 2	b	0					6.2	356
ce	dph	l		1 2	c	0					1.1	358
ce	dph	l		1 2	b	0				neonatal	1.4	380
ce	dph	r		1 2	b	0				neonatal	1	358
ce	dph	r		1 2	b	0					5.3	358
ce	dph	r		1 2	b	0					2.3	356
ce	dph	r		1 2	b	0					2.8	273
ce	dph	l		1 2	c	0					3.5	358
ce	dph	l		1 2	c	0					5.5	358
ce	dph	l		1 2	b	0					4.2	358
ce	ep	-		1	c	0					21.4	354
ce	ep	-			c	0					12.4	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	cp	-			d	0		2 cm	1		15.1	358
ce	fe	r			c	0					13.6	358
ce	fe	l			c	1					17.9	281
ce	fe	l	< 4 - 5 yrs	1	c	0					5	358
ce	fe	l	> 4 - 5 yrs	4	c	0					7	354
ce	fe	l	> 4 - 5 yrs	1 3	b	0					12.8	236
ce	fe	l	> 4 - 5 yrs	4 5	c	0	gn?			punc	17	281
ce	fe	r	5- 6 yrs		c	0					11.1	365
ce	fe	l	> 4 - 5 yrs	1 4 5	c	0		1 fm	1		20.9	361
ce	fe	r		#	b	0					5.5	365
ce	fe	r	< 5 - 6 yrs	9 # @	c	0					5.3	362
ce	fe	l		6	b	1		1 fm	7		20.8	358
ce	fe	l	> 4 - 5 yrs	4 5	c	0		3 fm	5		19.1	246
ce	fe	l	> 5 - 6 yrs	9	b	0					15.5	383
ce	fe	r	< 5 - 6 yrs		b	0					5.8	362
ce	fe	r			b	0		2 cm	@		3.1	358
ce	fe	l	> 4 - 5 yrs		b	0					2	356
ce	fe	r	< 5 - 6 yrs		b	0					3.2	361
ce	fe	l	< 5 - 6 yrs		b	0					1.2	281
ce	fe	r		# @	d	1					17.6	281
ce	fe	l	< 5 - 6 yrs	9	c	0					4.8	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	fe	l		9	d	0					2.6	362
ce	fe	l	< 5 - 6 yrs		b	0					8.8	356
ce	fe	l			b	0		1 cm, 2 fm	7, 8		10.3	412
ce	fe	l	> 5 - 6 yrs	#	b	0		3 fm	8		12.8	363
ce	fe	l	< 5 - 6 yrs		b	0					10.6	358
ce	fe	l	< 5 - 6 yrs	9 # @	c	0					15.8	358
ce	fe	l	> 5 - 6 yrs	9 # @	d	0					40	383
ce	fe	l	> 5 - 6 yrs	7 9 # @	c	0		1 fm	8		40.6	358
ce	fe	l	> 5 - 6 yrs	9 # @	b	0					40	281
ce	fe	l	> 5 - 6 yrs	9 # @	c	0					57.1	356
ce	fe	r	< 5 - 6 yrs	9 # @	c	0					14.1	358
ce	fe	r		2	b	0					6.4	358
ce	fe	r	< 4 - 5 yrs	5	b	0					5.7	365
ce	fe	r	> 4 - 5 yrs	1 2 3 4 5	b	0					32.3	356
ce	fe	r	< 4 - 5 yrs	2 3 6	b	0		12 fm	6		23.5	362
ce	fe	r	> 4 - 5 yrs	2 4 5	b	0					25	356
ce	fe	r		2 3	b	0					11.2	244
ce	fe	l			b	3					5.5	358
ce	fe	r		4	c	0					2.1	291
ce	fe	r	< 4 - 5 yrs	2 3 5	c	0					33.2	362
ce	fe	l	< 4 - 5 yrs	4	b	0				neonatal	1.9	273

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	fe	l	> 4 - 5 yrs	4	c	0		3 cm	4		3.7	356
ce	fe	l	< 4 - 5 yrs	4	c	0					1.6	361
ce	fe	r	< 5 - 6 yrs	9 #	c	0					10	358
ce	fe	r	> 5 - 6 yrs	@	c	0		4 fm	8		10.6	375
ce	fe	r	< 4 - 5 yrs	2 5	c	0					9.2	378
ce	fe	r	< 4 - 5 yrs	3 5	b	0					8	388
ce	fe	r	< 5 - 6 yrs	7 8	b	0		1 cm	8		58.7	358
ce	fe	r	> 5 - 6 yrs	# @	d	0					18.9	352
ce	fe	r	> 5 - 6 yrs	@	b	0					21.9	273
ce	fe	r	> 4 - 5 yrs	4 5	b	0		cm	4		11	358
ce	fe	r	> 5- 6 yrs	9 # @	c	0					48.4	378
ce	fe	r	> 5 - 6 yrs	7 8 9 # @	b	1		3 fm	8		63.3	356
ce	fe	r	> 5 - 6 yrs	9 @	c	0					19.3	361
ce	fe	r	< 5 - 6 yrs		b	0					15.9	258
ce	fe	r	> 5 - 6 yrs	7 8 9 # @	c	0					62.9	361
ce	fe	r		3 6	c	0					20.9	358
ce	fe	r	> 4 - 5 yrs	4 5	c	0					16.4	361
ce	fe	l	< 5 - 6 yrs	9	d	0					3.8	361
ce	fe	r		6 7 8	d	0					19.9	352
ce	fe	r	> 5 - 6 yrs	7 8 9 # @	b	0					60	356
ce	fe	l			b	0					17.7	368

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					9.9	380
ce	hu	l	> 2 - 3 yrs	4 6	d	0					8.9	246
ce	hu	l	> 2 - 3 yrs	4 6	d	0					9.2	281
ce	hu	l	> 2 - 3 yrs	4	c	1					7.5	365
ce	hu	l		7 8	b	1					110.4	362
ce	hu	l	< 2 - 3 yrs	3 4 5 6 7 8	b	2					14.6	356
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					9.5	273
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					18.9	280
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					13	354
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					20.8	362
ce	hu	l	> 2 - 3 yrs	3 4 5 6	b	0					20	358
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0					13.5	282
ce	hu	r	< 2 - 3 yrs	5 6	c	0					4.2	354
ce	hu	l	> 2 - 3 yrs	3 4 5 6	b	0					21.2	358
ce	hu	r	> 2 - 3 yrs	4	b	1		2 dm, 3 dm	8, 4		10.1	273
ce	hu	l	< 2 - 3 yrs	7 8 9 # @	b	0					21.3	388
ce	hu	r	> 2 - 3 yrs	4 5 6	c	0					9.7	356
ce	hu	l	< 5 - 6 yrs	@	c	1					10.4	356
ce	hu	l	< 2 - 3 yrs	7 8	b	0		1 cm	8		4.8	380
ce	hu	r	< 2 - 3 yrs	7 8	c	0					8.2	352
ce	hu	r	< 2 - 3 yrs	5 6	c	0					4.1	383

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	hu	l			c	0					7 1	363
ce	hu	r	< 2 - 3 yrs	5 6	c	0					4.7	363
ce	hu	r		8	c	1					17.7	363
ce	hu	l	> 5 - 6 yrs	1 2 9 # @	b	1		4 fm	@		59.7	356
ce	hu	l	> 5 - 6 yrs	1 2 @	b	0					24.8	358
ce	hu	l	< 5 - 6 yrs	@	b	1					17.8	354
ce	hu	l	< 5 - 6 yrs	2	c	0					6.9	281
ce	hu	r	< 5 - 6 yrs	2	c	0					3.5	358
ce	hu	r	> 2 - 3 yrs	3 4 5 6 7 8	c	0		2 fm	7		37	246
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0					23.1	362
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0					19.8	378
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0					24.1	358
ce	hu	r	> 2 - 3 yrs	4 6	b	0		2 dm, 3 fm, 6 dm	7, 7, 8		16.3	358
ce	hu	r	< 5 - 6 yrs	9 # @	b	0		1 fm, 2 fm	9, #		32.3	383
ce	hu	r	2 - 3 yrs	3 4 5 6	b	0					30.2	358
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0		1 dm, 4 fm	6, 8		34.8	361
ce	hu	l	> 2 - 3 yrs	4	d	0					5.8	280
ce	hu	r	> 2 - 3 yrs	3 4 5 6	b	4				burnt	19.8	412
ce	hu	r	> 2 - 3 yrs	3 4 5 6 7 8	c	0					32.8	378
ce	hu	r	> 2 - 3 yrs	4	d	0					3.5	280
ce	hu	r	> 2 - 3 yrs	3 4 5 6	b	0					30.1	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0		9 fm, 2 dm	7, 8		39.2	361
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0		4 dm, 2 fm	7, 8		30.6	361
ce	hu	r	> 2 - 3 yrs	3 4 5 6	b	0					43.7	358
ce	hu	r			c	0		3 fm	8		24.1	352
ce	hu	r	> 2 - 3 yrs	3 4 5 6	b	0					37.9	291
ce	hu	r	> 2 - 3 yrs	3 4 5 6	c	0		2 dm	6		20.3	361
ce	hu	r	> 2 - 3 yrs	3 4 5 6	b	0					37.8	356
ce	hu	l	> 2 - 3 yrs	3 4 5 6	b	0					28.3	273
ce	hu	r		7 8	d	0					17.9	380
ce	hu	r	< 5 - 6 yrs	2	b	0					8.5	356
ce	hu	l	> 2 - 3 yrs	4	c	0					6.9	354
ce	hu	l	> 2 - 3 yrs	3 4 5 6	b	0					25.6	356
ce	hu	r	> 2 - 3 yrs	3 4 5 6	d	0					12.5	352
ce	hu	l	> 2 - 3 yrs	3 4 5 6 7	c	0		4 cm	5		34.9	356
ce	hu	l	> 2 - 3 yrs	3 4 5 6 7 8	b	1		2 fm	8		43.7	358
ce	hu	l	> 2 - 3 yrs	3 4 5 6 7 8	c	0		7 fm	7		44.1	354
ce	hu	l	> 2 - 3 yrs	3 4 5 6 7 8	c	0		2 fm	8		47	358
ce	hu	r	> 5 - 6 yrs		c	0					12.2	358
ce	hu	r	> 5 - 6 yrs	1 2	c	0		1 cm	@		18.3	247
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0		1 cm	7		20.7	380
ce	hu	r	> 2 - 3 yrs	4 6	d	1					18.8	280

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	hu	l	> 2 - 3 yrs	3 4 5 6 8	b	0		7 fm	8		49.9	383
ce	hu	r	> 2 - 3 yrs	4	d	0					6.2	280
ce	hu	r	> 5 - 6 yrs	1 2 @	c	0		1 km	2		32.1	375
ce	hu	r		7 8	d	1					19.5	362
ce	hu	r			b	0					9.3	358
ce	hu	r	> 2 - 3 yrs		d	0					12.6	383
ce	hu	l	> 2 - 3 yrs	3 4 5 6	c	0		1 fm	8		32.7	358
ce	hu	r	> 5 - 6 yrs	1 2 @	c	0		4 dm	1		36.7	356
ce	hu	l	< 5 - 6 yrs	1	b	0					4.8	356
ce	mc	r	> 2 - 3 yrs	4	d	1					8.7	367
ce	mc	l		7 8	d	0					15.6	362
ce	mc	l	> 2 - 3 yrs	3 4	d	0		3 fm	7		18.1	362
ce	mc	-	> 2 - 3 yrs	$	d	2				? Burnt	4.9	273
ce	mc	l		5 6	c	0		12 fm	6		10.5	358
ce	mc	r	> 2 - 3 yrs	3 4	b	0					12.8	352
ce	mc	r			b	1					7	273
ce	mc	r	< 2 - 3 yrs		b	0					4.4	361
ce	mc	r	< 2 - 3 yrs	7 8	b	0					6.1	358
ce	mc	r	> 2 - 3 yrs	3 4	d	1					10.8	282
ce	mc	l	< 2 - 3 yrs	4	b	0					2.3	375
ce	mc	l			b	0		2 fm	8	calc con	5.7	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	mc	l	< 2 - 3 yrs	4	d	0					2.7	380
ce	mc	l	> 2 - 3 yrs	3 4	d	0					13.2	282
ce	mc	-	< 2 - 3 yrs		b	0					1.6	358
ce	mc	l		1 2	b	0		4 fm	6		10	378
ce	mp	-	< 2 - 3 yrs		c	0		5 fm	£		7.2	358
ce	mph	l	> 2yrs	1	c	0					1.7	380
ce	mph	l	> 2yrs	1 2 3	b	0					5.7	383
ce	mph	l	> 2yrs	1 2 3	b	0					6.8	358
ce	mph	r	2 - 3 yrs	1	b	0					0.6	273
ce	mph	l	> 2yrs	1 2 3	c	0	gn				6.2	362
ce	mph	r	> 2yrs	1 2 3	b	0	punc				4.5	361
ce	mph	r	> 2yrs	2 3	c	0					2.5	358
ce	mt	r			b	0					5.2	358
ce	mt	l			b	1				red stn	9.4	358
ce	mt	r		1 2	d	0					4.7	363
ce	mt	r			b	4					15.7	361
ce	mt	r	> 2 - 3 yrs	3 4	d	0					12.7	362
ce	mt	r	> 2 - 3 yrs	3 4 8	c	2				red staining	22.9	358
ce	mt	-	> 2 - 3 yrs	$	c	0					4	291
ce	mt	-	> 2 - 3 yrs	$	b	0					6.5	246
ce	mt	l			b	0					2.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	mt	r		2	b	0					2.3	282
ce	mt	l		2 6	b	1					9.1	356
ce	mt	r	> 2 - 3 yrs	3	d	0					4.3	380
ce	mt	l			b	0					2	282
ce	mt	r	< 2 - 3 yrs	7 8	c	0					6.6	361
ce	mt	l			b	0					10.5	358
ce	mt	l			b	0		1 fm	5		7.6	378
ce	mt	-			c	0					1.7	365
ce	mt	r		6	c	0					23.5	282
ce	mt	l		2	b	0		6 fm	5		11.1	357
ce	mt	l	> 2 - 3 yrs	3 4	b	0		7 fm	7		11	361
ce	mt	r	> 2 - 3 yrs	3 4	c	0					8.1	281
ce	mt	r	< 2 - 3 yrs		b	0					3.1	381
ce	mt	l	> 2 - 3 yrs		d	0					6.5	365
ce	mt	l	> 2 - 3 yrs	4	d	0					14.1	365
ce	mt	l	> 2 - 3 yrs	3 4	b	0					13.5	378
ce	mt	-			c	0					1.8	291
ce	mt	-			d	0					2.9	375
ce	mt	r			b	0					4.6	358
ce	mt	-	> 2 - 3 yrs	$	d	0					3.3	291
ce	mt	-	> 2 - 3 yrs	$	d	0					6.2	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	mt	-			c	0					3.2	365
ce	pe	r	> 1- 2 yrs	2 6	c	1		1 km	6		13 7	291
ce	pe	r		2 4 6	c	0					17	386
ce	pe	l	< 1- 2 yrs	3 8	b	0					1.8	273
ce	pe	r	< 1 - 2 yrs	2 4 6	c	0					20.1	356
ce	pe	l		7 #	d	1					15.2	352
ce	pe	l	< 1- 2 yrs	1	c	0					4	358
ce	pe	l	> 1- 2 yrs	1	b	0		wc	5		8	358
ce	pe	r	> 1- 2 yrs	1 2	b	2	punc				3.8	291
ce	pe	r	> 1- 2 yrs	1 5	b	0		2 dm			8.5	358
ce	pe	r	> 1- 2 yrs	3 8	b	0					4.2	385
ce	pe	l	> 1- 2 yrs	3 8	d	0					3.5	282
ce	pe	l	< 1 - 2 yrs	1 5 7 #	b	0					14.8	356
ce	pe	l	> 1- 2 yrs	3 8	b	0					3.7	378
ce	pe	r	> 1- 2 yrs	1 5	b	0					30	358
ce	pe	l		1	d	0					3	282
ce	pe	l		1 5	b	0					9.6	378
ce	pe	r		5	c	0					15.2	364
ce	pe	l	< 1- 2 yrs	2 4 6	b	0					7.3	358
ce	pe	l	< 1- 2 yrs	1 5 7 9 #	b	0					2.8	358
ce	pe	l	> 1- 2 yrs	2 6	c	0		6 km	1		11.7	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	pe	l	> 1- 2 yrs	2	c	0		3 dm.	2		7.8	378
ce	pe	l	> 1- 2 yrs	1 5	c	1					23.3	281
ce	pe	l	< 1 - 2 yrs	1 5	b	0		3 sm, 2 km	5		8.2	273
ce	pe	l	< 1- 2 yrs	1 5	b	0					3.7	356
ce	pph	r	> 2yrs	1 2 3	d	0					4.2	291
ce	pph	l	> 2yrs	1 2 3	b	0		3 dm, 15 ?fm	3, 3		9	361
ce	pph	r	> 2yrs	1 2 3	b	0					7.1	361
ce	pph	r	> 2yrs	1	c	0					3.2	354
ce	pph	r	> 2yrs	1 3	b	0					3.4	363
ce	pph	r	> 2yrs	1 2 3	c	0					3	358
ce	pph	l	> 2yrs	1 3	c	0					4.4	412
ce	pph	l		2	b	0	punc	1 dm	3		2	354
ce	pph	l		2	c	0		5 fm	3		1.6	362
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0	?gn	3 km	#		18.7	361
ce	ra	r	> 1 yr	1	c	0					4.2	281
ce	ra	l	< 4 - 5 yrs	3 4	c	0					4.2	291
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	1				spotty	16.1	354
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0					12.3	380
ce	ra	l	> 4 - 5 yrs	3 4 9 #	b	0					12.9	358
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0					10.4	305
ce	ra	l	< 4 - 5 yrs	3 4	c	0					4.2	246

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	ra	l	< 4 - 5 yrs	3 4	b	0					4.9	273
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0		1 cm	9-#		11.9	364
ce	ra	l	< 4 - 5 yrs	8 9 #	c	0					12.2	358
ce	ra	l	< 4 - 5 yrs	9 #	b	1				354A	9.4	354
ce	ra	l	< 4 - 5 yrs	9 #	c	0					8.7	281
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0					28.2	362
ce	ra	r	> 1 yr	2	b	0		3 km	5		3.1	358
ce	ra	l		1 2	b	0					11.8	356
ce	ra	r	> 1 yr	1	c	0					3.6	281
ce	ra	r	> 1 yr	1 2	c	0					5.6	358
ce	ra	r	> 1 yr	1	c	0					4.2	362
ce	ra	r	> 1 yr	1 2	d	0					3.3	367
ce	ra	r	> 1 yr	1	b	0					12.1	358
ce	ra	r		1	d	0				354A	2.6	354
ce	ra	l	young	1 2	c	0					3.3	356
ce	ra	l	< 4 - 5 yrs	9 #	b	0					7.4	358
ce	ra	l		6 7	b	0					8.1	358
ce	ra	l		6	b	0					5.8	362
ce	ra	r		6 7	b	0		2 fm	7		35.9	358
ce	ra	l		6 7	b	0		1 fm, 3 fm	6, 7		18.6	361
ce	ra	l		9 #	b	0		3 fm, 3 fm, 4 fm	8, 9 #		12.7	412

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	ra	l	> 1 yr		d	0					1.5	354
ce	ra	l	> 1 yr	2	b	0		6 km	5		5.6	273
ce	ra	l	> 1 yr	1 2	c	2					11.6	281
ce	ra	l	< 4 - 5 yrs	2	b	0					7.4	383
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0		4 fm	8		23.8	358
ce	ra	l		2	c	0		5 dm	5		9.3	354
ce	ra	l		1 2	b	0					11.6	273
ce	ra	l		1 2	d	0					5.3	246
ce	ra	l		1 2	c	0					6.2	383
ce	ra	l		1 2	c	0					10	381
ce	ra	l	> 1 yr	1 2	c	1					8.6	280
ce	ra	r	< 1 yr	5	b	0					8.9	358
ce	ra	l	> 4 - 5 yrs	3 4 8 9 #	b	1					29.7	356
ce	ra	l	> 4 - 5 yrs	3 4 9 #	c	0					23	358
ce	ra	l		1 2	c	0					2	380
ce	ra	r	> 4 - 5 yrs	3 4	c	1				spotty	7.9	373
ce	ra	r	> 1 yr	1 2	b	0					12.6	356
ce	ra	r	> 1 yr	1 2	b	0					12.1	358
ce	ra	r	> 1 yr	1 2	b	0					17.2	356
ce	ra	r	> 1 yr	1 2	c	0					21.2	378
ce	ra	r		1 2	b	0		1 dm	5		20.1	383

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	ra	r	> 1 yr	1 2 5	c	0					10.3	280
ce	ra	r	> 1 yr	1 2 5	c	1		2 dm	5		13.6	354
ce	ra	r	> 1 yr	1 2	c	0				354A	9.2	354
ce	ra	l	> 1 yr	2	c	0					6.3	273
ce	ra	r	< 4 - 5 yrs	3 4	b	0					9.2	352
ce	ra	r	> 4 - 5 yrs	3 4	c	0					8.9	361
ce	ra	r	> 4 - 5 yrs	3 4	b	0					10.2	356
ce	ra	r	> 4 - 5 yrs	3 4 9 #	b	0					21	356
ce	ra	r	> 4 - 5 yrs	3 4 8 9 #	b	0		9 fm, 6fm	8, #		31	363
ce	ra	r	> 4 - 5 yrs	3 4 8 9 #	b	0					33.2	358
ce	ra	r	> 4 - 5 yrs	3 4 8 9 #	c	1				spotty	32.5	281
ce	ra	l			b	0		km	8		3.5	356
ce	ra	r	young	5	c	0					7.5	358
ce	ra	l		1	d	4					3.8	365
ce	ra	r		1 2 5 6	c	0		5 km	5		25.4	380
ce	ra	r	> 1 yr	1 2	b	0					11.2	358
ce	ra	r	> 1 yr	1 2	c	0					7.2	362
ce	sc	r		1 2 3 4 5	b	0					26.4	356
ce	sc	r		1 2 3 4 5 6 7	b	1		1 fm	5		32.8	358
ce	sc	r		1 2 3 4 5	c	0		? vlt km	5		31.3	383
ce	sc	l		1 2 3 4 5	b	4					10	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	sc	l		1 2 3 4 5	c	0					6.2	362
ce	sc	l		1 2	c	0					4.9	361
ce	sc	r		1 2 3 4 5	b	2					22.1	356
ce	sc	r	< 1 yr	1 2 3 4 5 6 8	b	0					18.2	361
ce	sc	r		1 2 3 4 5	b	0					21.2	358
ce	sc	l		1 2 3 4 5	c	0					22.8	373
ce	sc	r	< 1 yr	1 2 3 4 5	c	1					10.5	378
ce	sc	l		1 2 3	b	0					8.7	361
ce	sc	r		1 2 3 4 5 6 8	b	1					49.9	358
ce	sc	r		1 2 3 4 5 7	b	0		1 fm, 4 fm	7, 9		59.7	273
ce	sc	r		3	b	0					4	246
ce	sc	r		1 2 3 4 5	c	0		1 dm	1		9.1	361
ce	sc	r		1 2 3 4 5	c	1					16	247
ce	sc	r		1 2 3 4 5	d	1					20	361
ce	sc	r		1 2 3	c	0		3 fm,	2		15.5	361
ce	sc	r		1 2 3 4 5 6 7 8	c	3				burnt	23.9	358
ce	sc	l		1 2 3 4 5	c	0					9.5	361
ce	sc	r		1 2 3 4 5	b	0					17.5	358
ce	sc	r		1 2 3 4 5	d	0					7.7	380
ce	sc	l		1 2	c	0					3.6	367
ce	sc	r		1 2 3 4 5	c	0		3 fm	1		19.5	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	sc	r		1 2 3 4 5	c	1					20.6	388
ce	sc	r		1 2 3	b	0		1 dm	3		7.7	356
ce	sc	r		1 2 3 4 5	b	1					17.6	378
ce	sc	r		4 5 6 7	b	1					9.6	358
ce	sc	r		1 2 3	d	0					4.5	208
ce	sc	r		1 2 3 4 5	d	0					11.9	280
ce	sc	l		1 2 3 4 5	c	1		1 fm	2		14.1	363
ce	sc	l		1 2 3	b	0					8.3	361
ce	sc	l		2 3	b	0					4.3	383
ce	sc	l		1 2 3 4 5 6 7	c	0					12.3	291
ce	sc	l		1 2 3 4 5	b	0					23.7	273
ce	sc	l		1 2 3 4 5	c	0					16.9	361
ce	sc	l		1 2 3	c	1					5.8	354
ce	sc	l		1 2 3 4 5	b	1		1 dm, 1 fm	3, 5		24.1	378
ce	sc	l		1 2 3 4 5	d	0					8.7	280
ce	sc	l		1 2 3 4 5	b	0		2 dm	2		23.2	358
ce	sc	l		1 2 3 4	b	0					16.3	357
ce	sc	l		1 2 3 4 5	b	0					15.6	358
ce	sc	l		1 2 3 4 5	b	0					27.6	388
ce	sc	l		1 2 3 4 5	b	0					19.6	358
ce	sc	l		1 2 3 4 5	c	0					13.5	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	sc	l		1 2 3 4 5	c	0		2 dm	3		16.5	362
ce	sc	l	< 1 yr	1 2 3	b	0					3.3	273
ce	sc	l	< 1 yr	1 2 3	c	0					4.8	358
ce	sc	l	< 1 yr	2 3	b	0		2 fm	2		3.3	358
ce	sc	l	< 1 yr	1 2 3	c	0					3.1	281
ce	sc	l		1 2 3 4 5	b	1					25 1	361
ce	sc	l		2 3	b	0					14	358
ce	sc	l		1 2 3	b	2		2 km	2		8.5	273
ce	sc	l		1 2 3 4 5	b	0					41.5	358
ce	sc	l		1 2 3 4 5	b	0					27.2	273
ce	sc	l		1 2 3 4 5 6 7	c	0		1 cm, 1 cm	4, 5		38.7	365
ce	sc	l	< 1 yr	1 2 3 4 5 6 7	b	0					9.8	358
ce	tb	r	< 5 - 6 yrs		b	0				punc	4 7	361
ce	tb	l			c	0					18.8	356
ce	tb	r	< 5 - 6 yrs		b	0					13 7	273
ce	tb	r	< 5 - 6 yrs		b	0					2.3	378
ce	tb	l	> 2 - 3 yrs	5	b	0		3 fm	#		9	361
ce	tb	r	< 5 - 6 yrs	1 2 3	b	0					7.9	358
ce	tb	r	> 5 - 6 yrs	1 2 3 4	b	0					29.2	356
ce	tb	r	< 5 - 6 yrs		b	0					15.7	378
ce	tb	r		9	b	0					50.3	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	tb	r	< 5 - 6 yrs	1 2 3	c	0				concretions	3.5	273
ce	tb	r		9	b	1					25.4	356
ce	tb	l			b	0					10.8	358
ce	tb	l		9	b	1					16.9	358
ce	tb	r	> 5 - 6 yrs		c	0					11.7	375
ce	tb	l	> 2 - 3 yrs	5	b	0					3	358
ce	tb	l	> 2 - 3 yrs	5 6	c	0					9.9	380
ce	tb	l	> 2 - 3 yrs	5 6	b	0					12.6	358
ce	tb	l	> 2 - 3 yrs	5 6 9 #	c	0		1 fm	#		29.6	375
ce	tb	l	> 2 - 3 yrs	5 6 9 #	b	0		2 fm	#		39.6	273
ce	tb	l	> 2 - 3 yrs	5 6 #	b	0		10 fm	#		42	362
ce	tb	r	< 5 - 6 yrs	1 2 3	c	0					4.8	354
ce	tb	l	> 2 - 3 yrs	6	d	0					7	246
ce	tb	l	> 2 - 3 yrs	6	d	0					4.3	356
ce	tb	r	< 2 - 3 yrs	5 6	c	0					2.1	282
ce	tb	r	> 2 - 3 yrs	5 6	b	0					14.3	356
ce	tb	r	> 2 - 3 yrs	5 6	b	0		3 fm	#		18.2	358
ce	tb	r	> 2 - 3 yrs	5 6 #	c	1					21	383
ce	tb	r	> 2 - 3 yrs	5 6 #	b	0					11.6	358
ce	tb	r	< 2 - 3 yrs	5 6	b	0					4.9	367
ce	tb	l	> 2 - 3 yrs	5 6 9 #	b	0		6 fm, c. 20 fm	9, #		52.1	367

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	tb	l	> 2 - 3 yrs	6	c	0					6.2	362
ce	tb	r	> 2 - 3 yrs	6	b	0		3 fm	#		13.7	362
ce	tb	l			b	0		4 fm, 3 fm	7, 8		12	358
ce	tb	l	> 2 - 3 yrs	6	c	0					2.7	362
ce	tb	l	< 2 - 3 yrs	#	b	0					5.8	358
ce	tb	l	> 2 - 3 yrs	6	b	0					4.2	361
ce	tb	l	> 2 - 3 yrs	5	b	0					3.8	362
ce	tb	l	> 2 - 3 yrs	5 6	c	0					8	362
ce	tb	l	> 2 - 3 yrs	5 6	d	0					4.8	281
ce	tb	l	> 2 - 3 yrs	5 6	d	1				burnt	7.9	363
ce	tb	l	> 2 - 3 yrs	6	b	0					3.5	361
ce	tb	l	> 2 - 3 yrs	5 6	c	0					7.6	388
ce	tb	l	> 2 - 3 yrs	5 6 #	d	0					15.4	363
ce	tb	l	< 2 - 3 yrs	5 6	c	0		2 dm	6		4.4	246
ce	tb	l	< 2 - 3 yrs	5 6	c	0					2.9	356
ce	tb	l	> 5 - 6 yrs	1 2 3 4	b	1					28	362
ce	tb	l	> 2 - 3 yrs	5 6	b	0					10.2	358
ce	tb	r	> 5 - 6 yrs	4	c	0					9.3	273
ce	tb	l			c	0					2.9	367
ce	tb	r	< 5 - 6 yrs	7	c	0					33.8	281
ce	tb	r	> 5 - 6 yrs	1 2 3	c	0		2 fm	7		24.9	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	tb	r	> 5 - 6 yrs	1 2 3 7	c	0					33.8	358
ce	tb	r	> 5 - 6 yrs	1 2 3 4	c	0					30.9	378
ce	tb	r	< 2 - 3 yrs		b	0					4.5	361
ce	tb	r	> 5 - 6 yrs	1 2 3 7	b	0		2 fm	7		52.3	356
ce	tb	l	< 2 - 3 yrs	#	b	0					6.1	356
ce	tb	r	> 5 - 6 yrs	4	c	0					13.7	378
ce	tb	r	> 5 - 6 yrs	1 2 3	c	0					20.9	357
ce	tb	r	5 - 6 yrs	1 2 3 4 7	c	0					37.1	358
ce	tb	r	> 5 - 6 yrs	4	c	0		5 fm	7		5.8	362
ce	tb	r	< 5 - 6 yrs		b	0					5.3	293
ce	tb	r	> 5 - 6 yrs	1 2 3	c	0		2 dm, 1dm	1, 2		24.6	362
ce	tb	r	> 5 - 6 yrs	1 2 3 4 7	b	0					73.5	358
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	c	0		4 km	7		23.6	280
ce	tb	r	< 5 - 6 yrs	7	c	0					16.2	351
ce	tb	l	< 5 - 6 yrs	7	c	0					4.9	246
ce	tb	l	< 5 - 6 yrs	2	b	0					2.6	361
ce	tb	l	< 5 - 6 yrs		b	0					1.8	381
ce	tb	l	> 5 - 6 yrs	1 2 3 4	c	0					16.7	273
ce	tb	l	> 5 - 6 yrs	1	d	0					15.2	246
ce	tb	r	> 5 - 6 yrs	2 3	b	0		10 fm	7		16.9	373
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	c	0					49.7	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	tb	l	> 5 - 6 yrs		c	0					8.1	380
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	c	0					17.8	282
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	b	0		4 fm	7		48.3	356
ce	tb	l	< 5 - 6 yrs	7	b	0		1 fm	7		31.3	373
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	b	0		1 dm	1		35.7	358
ce	tb	r	> 2 - 3 yrs		b	3		3 fm	#		7.1	273
ce	tb	r	< 2 - 3 yrs		d	0					5.1	362
ce	tb	l	> 5 - 6 yrs	1 2 3 4 7	c	0		1 cm	2 - 4		45.4	358
ce	ul	l		B C D E	c	1				spotty	12.2	365
ce	ul	l		B C D	b	0					9.3	378
ce	ul	r		D E F	b	0					2.8	358
ce	ul	l	< 4 - 5 yrs	C D	c	0		2 cm	C		3.4	362
ce	ul	l		C D	c	0					5.4	246
ce	ul	l	< 4 - 5 yrs	A	b	0					2.3	358
ce	ul	l	< 4 - 5 yrs	B C D E F	b	0					7	356
ce	ul	l			d	0				water/acid worn	3.5	365
ce	ul	l		C D	c	0		3 fm	C		5.3	358
ce	ul	l		B C D	c	0				water/acid warped	7.4	358
ce	ul	l	< 4 - 5 yrs	B C D E	b	0					8.7	356
ce	ul	l	> 4 - 5 yrs	A B C D	b	0					13.8	356
ce	ul	l		C D E	d	0				big check ID	26.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ce	ul	l		C D	c	0					10.1	380
ce	ul	r		B C D	d	0					6.1	356
ce	ul	r	> 4 - 5 yrs	A B C D E F	b	0		2 fm	E		23.5	356
ce	ul	r		B C D E F	b	0					24.1	358
ce	ul	l	< 4 - 5 yrs	A	d	0					0.6	65
ce	ul	l		B C	c	0					4.4	365
ce	ul	r			b	0					3.5	358
ce?	pph	r			c	0					1.4	213
ce?	pph	r			c	0					1.1	358
ec	ra	r		6 7	c	0					10	358
ec	ra	r		1	d	0		3 fm	5		5.5	358
ec	tb	r		1 2	c	0					24.6	362
ec	tb	l		1	c	0					6.8	361
ec	tb	r		#	d	1					40.3	365
hg	hu	r		7 8 9 #	b	0					32.2	53
hg	ra	l		5 6 7	c	0					10.2	358
hg	ra	l	juv	6 7 8	c	0		1 fm	7		7.1	362
hg	sc	l		1 2 3 4 5	b	0					22.7	358
hg	ul	l		C D E F G	b	0					31.8	358
hg	ul	l		B C D E F G	b	0		1 fm, 1 fm	E, F		31.9	358
hp/p	mt III	l		1 2	c	0		11 kn, 5 fm	1, 2		3.9	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgm	cal	r		1	d	0					4.1	362
lgm	fe	r			c	0					9.9	280
lgm	pe	r		3 8	b	0					2.5	385
lgm	pe	r		3	b	0					1.9	412
lgm	pe	r		3	c	0					2.2	273
lgm	pe	r		3	c	0					3.1	383
lgm	pe	l		8	b	0				neonatal	1.4	246
lgm	ra	l			b	0					15.1	361
lgm	sc	l		4	d	1					8.6	354
lgr	as	l		1 2 3 4	d	0					9	361
lgr	as	r		1 2 3 4	d	0					7.6	281
lgr	as	l		1 2 3 4	d	0					6.1	361
lgr	as	l		1 2 3 4	d	0					8	363
lgr	as	l		1 2 3 4	d	0					16.3	380
lgr	as	l		2 3 4	d	0					10.6	378
lgr	as	l		1 2 3 4	d	0					4.9	358
lgr	cal	r		2	b	0					1.8	356
lgr	cal	l		2	b	0		1 dm	2		3	361
lgr	cal	l		3 4 5	b	0				neonatal	2.6	358
lgr	cal	l		2	d	0					3.3	356
lgr	fe	r		9	d	0					3.6	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	fe	r		4	d	0					8.1	352
lgr	fe	r		4	b	0					12.2	362
lgr	fe	l		9 # @	d	0					9.7	281
lgr	fe	l		4	c	0					2.2	380
lgr	fe	r			b	0					2.2	358
lgr	fe	l		4	c	0					4.5	381
lgr	fe	l			b	0					3.3	358
lgr	fe	-		4	c	0					9.8	381
lgr	hu	r			b	0	gn				10	358
lgr	hu	r		5 6	d	0					7.8	380
lgr	hu	l			c	0					10.4	388
lgr	hu	l		2	b	0					7.4	380
lgr	hu	l		2	c	0					9.6	380
lgr	hu	l		2	c	0					5	281
lgr	hu	l		2	c	3					5.6	354
lgr	hu	r			b	0					2.1	383
lgr	hu	r			b	0					3.7	381
lgr	hu	r			c	0					3.5	358
lgr	hu	l			c	0					4.3	358
lgr	hu	l		6	d	1					6.9	354
lgr	hu	l			c	4				burnt	29.5	381

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	hu	r			b	0					13	358
lgr	hu	l		2	b	0					4.4	273
lgr	hu	r		9 # @	b	0					23 1	358
lgr	hu	r			b	0					6 1	356
lgr	hu	l		7 8	b	0					5.3	361
lgr	hu	l			c	4				burnt	9.2	354
lgr	hu	l		4 5 6	d	0					7 3	358
lgr	hu	l			b	0					8.3	358
lgr	hu	r		6	d	1					3.8	354
lgr	mc	-			b	0	gn				5 3	356
lgr	mp	-		$	b	0					2.9	356
lgr	mp	-		$	d	4				burnt	5.4	381
lgr	mp	-			d	0					5	360
lgr	mp	-		$	d	0					9.1	356
lgr	mp	-		$	b	0					1.6	356
lgr	mp	-		$	b	0					2.4	358
lgr	mp	-		$	b	0					2.3	358
lgr	mp	-		$	b	0					1.4	356
lgr	mp	-		$	c	0					2.1	273
lgr	mp	-		$	b	0					2.6	273
lgr	mp	-		$	c	0					2.5	273

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	mp	-		$	b	0					2 4	356
lgr	mp	-		$	b	0					1.4	356
lgr	mp	-		$	b	0					1.2	356
lgr	mp	-		$	d	0					2.2	358
lgr	mp	-		$	c	0					4.4	363
lgr	mp	-		$	c	0					3.7	361
lgr	mp	-		$	d	0					1.6	367
lgr	mp	-		$	d	0					3.4	380
lgr	mp	-		$	d	0					3 9	273
lgr	mp	-		$	b	0				neonat	1.3	358
lgr	mp	-		$	b	0					1.3	361
lgr	mp	-			c	0					1.5	358
lgr	mp	-			b	0					1.5	378
lgr	mp	-		$	c	0					3	354
lgr	mph	l		2 3	c	0					1.2	358
lgr	mph	l		2 3	c	0					1.2	358
lgr	mph	l		2 3	b	0					1.5	356
lgr	mph	l		2 3	c	0					1.2	358
lgr	mph	l		1	b	0					0.9	358
lgr	mph	l		1 2 3	b	0					2.1	356
lgr	mt	l			b	0					1.7	146

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	mt	r			c	0					5.4	358
lgr	mt	l			d	1					12.2	354
lgr	pe	r		3 8	d	0					3.6	380
lgr	pe	r		3 8	c	0					3.4	291
lgr	pe	r		5 7	c	0					4.1	273
lgr	pe	l		3 8	d	0					3.6	291
lgr	pe	r		5	c	0					6.1	358
lgr	pe	l		1	d	0					7.8	388
lgr	pe	r		2 4 6	c	0					5.7	356
lgr	pph	r		2 3	b	0					1.6	356
lgr	pph	r		2	d	0					1.2	358
lgr	pph	l			c	0					1.5	363
lgr	pph	r		2 3	b	0					1.8	356
lgr	pph	r		2 3	b	0					1.9	358
lgr	pph	r		2	d	2					2.3	362
lgr	pph	l		2 3	c	0					0.9	358
lgr	pph	l		2 3	b	0					2	271
lgr	pph	l		1	d	0					1.3	271
lgr	pph	l		2 3	b	0					1.5	273
lgr	ra	l		2	b	0		5 dm	5		1.7	358
lgr	ra	r		6 7 8	b	0				neonat	5.8	281

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	ra	l		8	d	0					1.9	367
lgr	ra	l		9 #	c	1					1 8	367
lgr	ra	l		6 7 8	b	0				neonat	4.7	358
lgr	ra	l			b	0					9.3	356
lgr	ra	l		3 4	d	0					1.4	358
lgr	ra	r		5	b	0		2 fm	5		5	358
lgr	ra	r		1	d	0					4.9	352
lgr	sc	l		2 4	d	0					4.3	297
lgr	sc	l			c	0					3	281
lgr	sc	l		3	b	0		1 fm	3		5.9	358
lgr	sc	l		1 2 3	d	0					4.6	380
lgr	sc	r		1 2 3	b	0					6.5	273
lgr	sc	r			b	0					5.8	358
lgr	sc	r		1 2 3	c	1					7.2	362
lgr	sc	r		1 2 3 4 5	c	1					9.5	383
lgr	sc	r			b	0					2.5	354
lgr	sc	r		2 3	d	0					4.9	381
lgr	sc	l			b	0					2.4	358
lgr	tb	l			b	0					1.9	362
lgr	tb	l		5 6	b	0					0.9	361
lgr	tb	r			c	0					8.6	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
lgr	tb	l		1 2 3	d	0					5	356
lgr	tb	l		#	b	0					7.7	367
lgr	tb	l			c	0					2.6	358
lgr	tb	l			d	0					7.3	356
lgr	ul	l			b	0				burnt	3.2	246
lgr	ul	l		C	c	0					0.8	378
lgr	ul	l		B C D E	d	0					3.1	358
lgr	ul	r		C	b	0					3.9	362
lgr	ul	r		8 9 #	b	0					10.3	363
lgr	ul	l		C	d	0					1.9	354
lgr	ul	l		B	c	0					2.5	358
ll	cal	l		1 2 3 4 5	b	0					1.6	662
ll	hu	l		7 8 9 #	b	0					1.8	358
ll	ul	l		B C D E F G H	b	0					3.2	412
ll	ul	l		C D	b	0					0.5	291
mdm	fe	r			b	0					2.3	358
mdm	fe	r		2 3 5 6	b	0					1.4	367
mdm	fe	r		9 # @	d	0					4.5	358
mdm	mph	l		2	c	0					0.5	358
mdm	mph	l		2 3	c	0					0.9	358
mdm	pe	r		3 8	b	0					1.3	291

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
mdm	pe	r		2	b	0					1	291
mdm	pe	r		1	c	0					4	381
mdm	pe	r		2 6	b	0					1.6	358
mdm	pe	r		2 6 @	b	0					4.1	356
mdm	pe	r		3 8	c	0					1	356
mdm	pe	r		2 6	b	0					1.8	381
mdm	pph	r			c	0					0.1	358
mdm	pph	r		2 3	c	0					0.7	358
oa	as	r		1 2 3 4	b	0					3.6	358
oa	as	l		1 2 3 4	b	0		7 dm	3		3.4	361
oa	as	l		1 2 3 4	c	0	gn	3 dm, 9 *dm*, 6 dm	2, 3, 4		3.2	362
oa	as	l		1 2 3 4	c	0					1.9	362
oa	as	l		1 2 3 4	b	0					5.1	358
oa	as	l		1 2 3 4	c	0					3.5	282
oa	as	l		1 2 3 4	c	0		2 dm	4		3	381
oa	as	r		1 2 3 4	c	0					1.4	273
oa	as	r		1 2 3 4	b	2				burnt	2.2	246
oa	as	r		1 2 3 4	b	1					3.4	236
oa	as	r		1 2 3 4	c	0					3.8	380
oa	as	r		1 2 3 4	c	4				burnt	4	356
oa	as	r		1 2 3 4	b	0		3 dm, 2 dm, 2 dm, 1 dm	1, 2, 3, 4		3.2	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
oa	as	r		1 2 3 4	d	0					2.5	291
oa	cal	r		2 3 4 5	b	0					4.9	356
oa	cal	r		2 3 4 5	b	0					5.9	358
oa	cal	r		1 2 3 4 5	b	0					3.1	373
oa	cal	r		2 3 4 5	b	0					2.5	273
oa	cal	r		1 2 3 4 5	b	0					4.7	358
oa	cal	l		2 3 5	b	0					3.3	358
oa	dph	l		1 2	b	0					0.4	273
oa	fe	l		1 2 3 4 5	b	0					6.5	356
oa	fe	r			c	0					5	412
oa	fe	l		@	b	0					10.3	378
oa	fe	l		7 9 # @	c	0					14.9	273
oa	fe	l		@	d	0					4	362
oa	fe	l		9 # @	c	0					4.4	358
oa	fe	r		9 #	c	0		2 dm	#		5.7	352
oa	hu	r		3 4 5 6	c	0					6.5	356
oa	hu	l		3 4 5 6 7 8	b	0					9.9	358
oa	hu	r		3 4 5 6 7 8	b	0					10	383
oa	hu	r		1 2 @	b	2					14.4	273
oa	hu	r		1 2 @	b	0		4 fm	@		11	356
oa	hu	l		1 2	c	0					5.1	380

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
oa	hu	l		3 4 5 6	c	0		2 km, 2 dm	7, 8		3.5	361
oa	hu	l		3 4 5 6	b	0					4.7	358
oa	hu	l		4 5 6	c	0					2.6	361
oa	hu	r		6	c	0					1.7	361
oa	hu	l		3 4 5 6	c	4				burnt	7.2	273
oa	mc	r		5 6 7 8	c	0					5.9	358
oa	mc	r		1 2 5 6	c	0		3 cm, 10 km, 13 km, 19 k	5, 5, 6, 7, 8		10.8	358
oa	mc	r		1 2 5 6	b	0					6.8	273
oa	mc	r		1 2 5 6	b	0		4 fm, 5 fm, 1 fm	5, 6, 8		11	412
oa	mc	l		1 2 3 4 5 6 7 8	b	0					16	412
oa	mc	l		3 4 7 8	c	1					4.7	356
oa	mc	l		3 4	b	0		5 fm	8		3.7	380
oa	mc	l		3 4	c	4		6 fm, 1 dm	7, 8	burnt	4.3	358
oa	mc	l		1 2	b	0					2.2	358
oa	mc	r		3 4 7 8	c	0		1 cm, 8 dm, 4 sk m	7 - 8, 8, 7 -		6.5	358
oa	mc	l		1 2	c	1					3.4	356
oa	mc	r		2 3 4 5 6 7 8	b	0		4 fm	7		11	358
oa	mc	r		1 2 5 6 7 8	c	3				burnt	7.4	356
oa	mc	r		1 2	c	0		6 km	5		1.7	378
oa	mc	r		1 2 3 4 5 6 7 8	b	0		6 km, 3 km, 1 km	5, 7, 8,		19.5	358
oa	mph	r		1 2 3	b	0					0.9	381

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
oa	mph	r		1 2 3	b	0					0 4	358
oa	mph	r		1 2 3	b	0					0.9	358
oa	mph	l		1 2 3	c	0					0 7	361
oa	mph	l		1 2 3	c	0					0.7	361
oa	mt	r		3 4	c	0					4.2	273
oa	mt	r		1 2 5 6	b	0					7.6	358
oa	mt	r		1 2 5 6	b	0		5 km, 1 km	5, 6		2.6	358
oa	mt	r		1 2 5 6	b	0					4.2	273
oa	mt	l		3 4	b	0					5.5	358
oa	mt	r		3 4	c	0					3.6	381
oa	mt	l		1 2 5 6 7 8	b	0	gn	1 km	5		19.2	358
oa	mt	l		3 4	c	0					2.3	358
oa	mt	r			c	0		2 dm, 5 dm	5, 6		2.8	356
oa	pph	l		1 2 3	c	0					2	282
oa	pph	r		1 2 3	b	0					2	358
oa	pph	l		1 2 3	c	0					1.8	381
oa	pph	l		1 2 3	b	1					1.2	356
oa	pph	l		1 2 3	b	0					1.8	273
oa	pph	l		1 2 3	c	0					1.2	358
oa	pph	l		1 2 3	b	0					1.7	291
oa	pph	l		2 3	b	0					1.3	291

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
oa	pph	l		2 3	b	0					1	273
oa	pph	r		2 3	b	0					1	273
oa	pph	r		1 2 3	c	0					2	378
oa	pph	r		1 2 3	c	0					1.4	273
oa	pph	r		1 2 3	b	0					1.7	358
oa	pph	r		1 2 3	b	0					1.6	358
oa	pph	r		1 2 3	c	0					1.6	361
oa	pph	r		1 2 3	c	0					1.9	358
oa	pph	r		2 3	b	0					0.9	358
oa	pph	r		2 3	b	0					0.8	273
oa	pph	r		2 3	c	0					0.8	358
oa	ra	r		A B C	b	1					3.2	361
oa	ra	r		1 2 5	d	0					2	365
oa	ra	r		A B C D	c	0					4	378
oa	ra	l		3 4 9 #	b	1					6.2	381
oa	ra	l		3 4 9 # H	c	0					5.1	361
oa	ra	r		6 7 8 9 #	c	0					7.3	358
oa	ra	r		1 2 5	c	2					4.5	378
oa	ra	l		1 2	b	0		2 dm	5		2.6	358
oa	sc	r		1 2 3 4 5	b	0					6.4	358
oa	sc	l		1 2 3 4 5	c	0					6.7	362

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
oa	sc	l		1 2 3 4 5 6	c	0					9.1	358
oa	sc	r		1 2 3 5	b	0					2.3	358
oa	sc	r		1 2 3 4 5	c	0					2.6	352
oa	sc	r		1 2 3 4 5	b	0					4.6	361
oa	sc	l		1 2 3 4 5	c	0					4.3	354
oa	sc	r		1 2 3 4 5	b	0		4 dm, 3 fm	2, 5		10	273
oa	sc	r		1 2 3 4 5	b	0		1dm, 1 dm,	1, 2,		8.7	383
oa	sc	r		1 2 3 4 5	b	0					5.5	356
oa	ul	l		A B	d	0					2.5	354
ovc	as	l		2	b	0					2.6	364
ovc	as	l		3 4	d	0					1.1	367
ovc	as	l		1 2 3 4	d	0					5.6	291
ovc	at	-			b	0					2.2	375
ovc	cal	r		2 3	b	0					3.2	358
ovc	ep	-		1 2 3 4	b	0					9.2	362
ovc	ep	-			c	0					2.9	383
ovc	ep	-		1 2 3 4	d	0					14	362
ovc	ep	-			c	0					5.9	352
ovc	ep			1 2 3 4	c	0		3 dm			7.2	363
ovc	fe	l		2 5	c	0					0.9	362
ovc	fe	r		2 3 5 6 7 8	c	0					14.9	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ovc	fe	r		7 8	c	0					7.5	258
ovc	fe	l		1	b	0					1.2	291
ovc	fe	r		9 # @	d	0					4.3	273
ovc	fe	l		8	b	0		5 fm, 3 fm	7, 8		8	358
ovc	fe	l		7	b	0		3 fm	7		6.5	356
ovc	fe	l		2 3 5	b	0		1 fm, 2 fm	2, 3		5.9	358
ovc	fe	l			c	0					4.1	358
ovc	fe	l		4	c	4				burnt	2.6	356
ovc	fe	l		9 # @	d	0					3.9	273
ovc	fe	l			c	0		1 dm	7		8	362
ovc	fe	l			b	0		1 dm	8		5.8	273
ovc	fe	l		4	b	0					1.1	362
ovc	fe	l			b	0					3.1	357
ovc	fe	l		7	b	0					11.9	356
ovc	fe	r		5	b	0					3.6	273
ovc	fe	l		4	b	0					1	282
ovc	fe	r		6 7 8	c	0	gn				5.8	367
ovc	fe	r		6 7 8	b	0		4 fm	6		8.1	273
ovc	fe	r		2 3 5 6	b	0					5	281
ovc	fe	r		4	b	0					1.2	291
ovc	fe	r		2 3 5 6	b	0					3.8	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ovc	fe	r		2 3 5	b	0					3.3	362
ovc	hu	r		3 5 6 7 8	c	1					5.3	361
ovc	hu	l		5 6	c	0					1.3	356
ovc	hu	l		3 5 6 8	b	0					4.8	361
ovc	hu	l		3 4 5 6	c	4				burnt	4.9	358
ovc	hu	r		5 6	c	0					2.4	291
ovc	hu	r		6	c	0					2	363
ovc	hu	r		7 8	c	0					4.7	358
ovc	mc	l		1	c	0					1.9	358
ovc	mc	r		5 6 7 8	c	0					12.4	354
ovc	mc	r		7	c	0		6 fm, 2 fm	5-6, 7-8		5.5	358
ovc	mc	r		1 2	c	1					0.9	291
ovc	mc	-			c	0					1.5	358
ovc	mc	r		1 2 5 6 7 8	c	0					5.6	358
ovc	mc	l		3 4 7 8	c	0					5.5	412
ovc	mc	l		7 8	c	4					3.6	358
ovc	mc	r		7 8	c	0		1 km	7		4.9	358
ovc	mc	l		1 5	b	0		4 dm	5		3	358
ovc	mt	l			b	0		7 dm	6		3.8	358
ovc	mt	l		7	c	0		7 km	7		7.4	412
ovc	mt	r		2	b	0		3 dm	6		1.7	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ovc	mt	l		7 8	c	0					3.2	362
ovc	mt	r		4	d	0					1.7	361
ovc	mt	r		1 2 5 6 7 8	c	0					6.8	361
ovc	mt	r		1 2 5 6 7 8	c	1		8 km	7 - 8		12	358
ovc	pe	r		1 5	c	0					4.8	358
ovc	pe	l		1 4 5	c	0					5.2	358
ovc	pe	r		1 2 3 4 8	b	0					4.1	412
ovc	pe	l		3 8	c	0					1.7	354
ovc	pe	r		1 2 4 5 6 @	b	0					11.5	358
ovc	pe	r		1 5	b	0					1.6	381
ovc	pe	l		2 6	b	0					1.6	356
ovc	pe	l		2 6	b	0					2.1	358
ovc	pe	l		2 4 6 @	b	0					6.2	358
ovc	pe	r		3 8	b	0					1.3	358
ovc	pe	l		3 8	b	0	punc				0.6	383
ovc	pe	l		3 8	b	0					1.3	358
ovc	pe	l		1 5	b	0					3.1	381
ovc	pe	l		1 2 4	b	0					5.8	358
ovc	pe	r		5	b	0					2.7	356
ovc	ra	l			d	1				abraded	2.7	246
ovc	ra	r		9 #	b	0					2.6	356

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ovc	ra	l		6 7 8	b	0		3 dm, 4 dm	7, 8		5.1	358
ovc	ra	r		6 7	b	0					3.7	358
ovc	ra	r		9 #	b	0					4.5	412
ovc	ra	r		3 4	c	0					3.6	358
ovc	ra	r		5 6 7 8 9 #	b	0		2 dm	5		17.1	358
ovc	ra	l		6 7	b	0		dm	6		3.2	358
ovc	ra	l		6	b	0		30+ fm	6 - 8	? Same indiv as 190??	3.9	412
ovc	ra	l		#	b	0					5.4	358
ovc	ra	l			c	0		2 fm	5		2.6	383
ovc	ra	l		1 2	d	0					2	367
ovc	sc	l			b	0					0.7	362
ovc	sc	r		1 2 3	b	0					3.2	356
ovc	sc	r			b	0					1	380
ovc	sc	l			c	0					1.9	361
ovc	sc	r		1 2 3	b	0					1.6	361
ovc	tb	l		5 6 #	b	0					5.6	383
ovc	tb	r		5	b	0		1 dm	6		0.7	358
ovc	tb	l			b	0					3.2	356
ovc	tb	l		5 6 #	b	0		14 fm	#		7.5	362
ovc	tb	r		5 6 8 9 #	b	0		2 dm	8		21.7	358
ovc	tb	l		5 6	c	0					2.2	358

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ovc	tb	r		5 6 #	b	0					14.3	273
ovc	tb	r		5 6	b	0					1.9	381
ovc	tb	r		5 6	b	0					1.5	356
ovc	tb	r		5 6	b	0					1.5	412
ovc	tb	r		1 2 3	c	0					1	273
ovc	tb	l		5 6	c	0					1	273
ovc	tb	l		5 6	b	0					1.8	358
ovc	tb	l		9 #	c	0					7.7	358
ovc	tb	r		5 6	b	0					1.5	358
ovc	tb	r		1 2 3	c	0					1.2	361
ovc	tb	r			b	0					2.3	356
ovc	tb	r		1 2 3 4 5 6 7 8 9 #	b	0					3.1	361
ovc	tb	l		5 6 #	b	0	gn	1 fm, 1 fm	9, #		9.3	358
ovc	tb	r		8	b	0					5.1	358
ovc	ul	r		B C D E	d	0					2.8	291
pv	fe	l		1 2 3 5 6 7 8 9 # @	b	0		1 kn	8		40.7	358
pv	fe	r		2 3 4 5 6 8	b	0		2 kn	8		23.8	358
pv	ra	l	juv	5 6 7	b	0					3.3	358
pv	ra	r	juv	6 7 8	b	0					6.1	358
pv	sc	l		1 2 3 4 5 7	b	0		1 fm, 2 fm, 1 fm, 1 fm	1, 2, 3, 5		21.7	358
pv	sc	r		1 2 3 4 5	c	0					11.1	412

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
slm	tb	l			b	0					1.5	358
slr	cal	r		1 2	c	0		8 dm	2	burnt	1.2	358
slr	cal	r		2	b	0		1 dm	2		0.4	365
slr	fe	l		6 7 8	b	0					6.7	358
slr	fe	l		6 7 8	b	0					3.6	356
slr	hu	l		7 8	c	0					3.4	356
slr	hu	l			b	0					2.7	358
slr	hu	r		7 8 9 # @	b	0				neonat	2.8	358
slr	hu	r		@	b	0		2 cm	@		3.4	358
slr	hu	l		7 8 9 # @	d	0					4	383
slr	mc	-		$	b	0					1.2	358
slr	mc	-		$	b	0					0.8	358
slr	mc	-		$	c	0					0.6	358
slr	mc	-		$	c	0					0.7	358
slr	mc	-		$	c	0					0.7	291
slr	mc	l		7 8	b	0					1.5	273
slr	mc	l		6 8	b	0					1.1	412
slr	mc	-		£	b	0					1.5	381
slr	mp	-			c	0					1.5	361
slr	mp	-			c	0					3	281
slr	mp	-			c	0					1.6	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
slr	mp	-		$	c	0					0.8	381
slr	mp	r			d	0					2.7	358
slr	mp	-		7 8	b	0		6 km	7 - 8		2.8	381
slr	mt	l			b	0					1.3	356
slr	mt	r		7 8	c	0					1.7	358
slr	mt	r			b	4				burnt	5	354
slr	mt	l		5 6	c	0					1.5	362
slr	mt	l			b	0					0.5	381
slr	mt	-		$	c	0					0.9	381
slr	mt	-		$	b	0					0.7	358
slr	mt	-			b	0					3.5	358
slr	ra	l		5 6 7 8 9 #	b	0					8	358
slr	ra	r		1 2 5	c	0		2 dm	5		9.8	358
slr	ra	r		6 7 8	b	1				chopped thru vert	9.2	273
slr	ra	r			c	0					4.9	362
slr	ra	r		6 7	c	0	gn				7.3	383
slr	ra	r			c	0		2 dm	5		1.7	381
slr	tb	l		8	b	0		8 fm	8		5.2	358
slr	tb	l		7	b	0					6.6	375
slr	tb	r		5	b	0					0.6	381
slr	tb	r		5 6	d	0					1.3	282

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
slr	tb	r			b	0					1 8	358
ss	as	r		1 2 3 4	c	0		2 dm	4		10.5	358
ss	as	r		1 2 3 4	c	0		2 dm, 2 dm	1, 2		5 7	356
ss	as	r		1 2 3 4	c	0					8.9	358
ss	cal	l		1 2 3 4 5	b	0					9.5	273
ss	cal	r		1	d	0					1.2	358
ss	cal	l		2 3 4 5	b	0		2 dm	2		5.1	361
ss	cal	l		2 3 5	b	0		4 dm	2		3.4	358
ss	cal	r		2 3 4 5	c	0					8.1	358
ss	cal	r		2 3 4 5	b	0					12	358
ss	cal	l		2 3 4 5	b	0					6.6	273
ss	dph	r		1 2	b	0					1.1	273
ss	dph	r		1 2	b	0					1	361
ss	dph	l		1 2	b	0					1.1	358
ss	dph	r		1 2	b	0					1.8	273
ss	fe	l		@	b	0					2.2	364
ss	fe	l		9 # @	c	0					18.8	352
ss	mc	-		1 3	b	0				Mc III	5.2	358
ss	mph	l		1 2 3	b	0					1.3	273
ss	mt iv	l		1 3	b	0					2.8	358
ss	pe	r		1 2 3	d	0					9.4	361

Sp	Elem	Side	Age	Frag(> 5	Pres	St	Gn	Butchery	Bu zone	Other	Weight	Context
ss	pph	r		1 2 3	c	0					4.7	385
ss	ra	l		1 2	b	0				neonat	2	246
ss	ra	r		2	b	0					1.1	358
ss	ra	l		8 9 #	b	0					2.7	383
ss	ra	l		1 2	b	0					3.2	358
ss	sc	r		1 2 3	c	0					10.9	358
ss	sc	r		3	b	0					4.6	361
ss	sc	l		1 2 3 4 5	c	0		6 dm, 1 dm	3, 2		9.4	358
ss	ul	r		A	b	0					2	383
ss	ul	l		A	c	0					4.9	358

Appendix 3.1 sample processing using a flotation tank

The processing machine consists of a tank with an inlet pipe connected to a water supply. Often this pipe takes the form of a perforated metal pipe or 'rose', which sprays water upward with moderate force. Many machines have a second water inlet in the form of a small hand-held hose. An outlet valve allows the level of water in the tank to be controlled. A weir or spout at the top of the tank allows water to spill over through a sieve or rack of sieves.

Sediment is placed in a mesh suspended above the water spraying 'rose' pipe and the tank allowed to fill. The material is gently disaggregated by hand and hose and allowed to soak in the water for a short time. When the material has been broken up by the action of the water the tank can be filled and allowed to overflow through the sieves. This collects the 'flot' – any floating material, generally carbonised seeds, smaller fish bones, charcoal and occasional fragments of larger animal bone. Larger, heavier artefacts and ecofacts are retained in the mesh and are called the 'retent' or 'residue'. When the residue is cleaned of all the surrounding (usually soil) matrix, and no further material is floating in the water, the process is finished, the tank emptied and both the flot and residue are removed for drying. Cleaning of the mesh and sieves prevents cross-contamination before the next sample is processed.

Appendix 4.1

Appendix 4.1 provides the tables that Figures 4.11 to 4.13 are based on. Calculations follow O'Connor (2000, 72 – 73). Column R is the minimum number of the skeletal part retrieved, while "I" represents the number of each skeletal part in the individual animal. Dividing R

by I provides the "observed" figure "O". The arithmetic mean is then calculated to give the expected figure (E) if the specimens in the sample were evenly distributed across all elements. The observed figure divided by the expected figure gives the ratio O/E. The ratio indicates how much more or less abundant each skeletal part is than the mean. Calculation of the standard deviation of the O/E figures identifies which elements lie one standard deviation above the mean (in bold type) or below it (in italics; O'Connor 2000, 73).

Appendix 4.1: Table 1: Element representation analysis of cattle in Phase 1

Phase 1	**R**	**I**	**O**	**O/E**
ast	8	2	4.00	**2.87**
mc P	5	2	2.50	**1.80**
tb P	5	2	2.50	**1.80**
mt P	4	2	2.00	1.44
mt D	4	2	2.00	1.44
cal	3	2	1.50	1.08
fe P	3	2	1.50	1.08
sc	3	2	1.50	1.08
tb D	3	2	1.50	1.08
ul	3	2	1.50	1.08
at	1	1	1.00	0.72
ep	1	1	1.00	0.72
hu D	2	2	1.00	0.72
mc D	2	2	1.00	0.72
mn	2	2	1.00	0.72
pe	2	2	1.00	0.72
ra P	2	2	1.00	0.72
ra D	2	2	1.00	0.72
pph	5	8	0.63	0.45
dph	4	8	0.50	*0.36*
fe D	1	2	0.50	*0.36*
mph	4	8	0.50	*0.36*
	69		T = 30.63	SD = 0.59
		E (T/ 22)	E = 1.39	

Key to tables:
E – expected figure (if elements distributed equally)
SD – standard deviation
R – minimum number of skeletal part retrieved
I – number of that skeletal part in an individual animal
O – R/I – the "observed" number of each skeletal part
T – sum of O
(For key to element abbreviations see Figure 4.13).

Appendix 4.1: Table 2: element representation analysis of cattle in Phase 2

	R	I	O	O/E
ast	11	2	5.50	3.09
mn	8	2	4.00	2.25
cal	7	2	3.50	1.97
mc P	5	2	2.50	1.40
mt D	5	2	2.50	1.40
ra P	5	2	2.50	1.40
mph	16	8	2.00	1.12
mt P	4	2	2.00	1.12
fe D	3	2	1.50	0.84
pe	3	2	1.50	0.84
ra D	3	2	1.50	0.84
sc	3	2	1.50	0.84
pph	10	8	1.25	0.70
fe P	2	2	1.00	0.56
mc D	2	2	1.00	0.56
tb D	2	2	1.00	0.56
ul	2	2	1.00	0.56
hu P	1	2	0.50	0.28
hu D	1	2	0.50	0.28
tb P	1	2	0.50	0.28
dph	1	8	0.13	*0.07*
	95		E = 1.78	*SD = 0.73*
				0.27 - 1.73

Appendix 4.1: Table 3: element representation analysis of cattle in Phase 3

	R	I	O	O/E
mc P	16	2	8.00	**3.24**
mc D	12	2	6.00	**2.43**
pph	41	8	5.13	**2.07**
mph	36	8	4.50	**1.82**
dph	34	8	4.25	1.72
ast	8	2	4.00	1.62
fe P	4	2	2.00	0.81
mn	4	2	2.00	0.81
mt D	4	2	2.00	0.81
cal	3	2	1.50	0.61
fe D	3	2	1.50	0.61
mt P	3	2	1.50	0.61
ra P	3	2	1.50	0.61
ra D	3	2	1.50	0.61
tb P	3	2	1.50	0.61
tb D	3	2	1.50	0.61
at	1	1	1.00	0.40
hu D	2	2	1.00	0.40
pe	1	2	0.50	0.20
sc	1	2	0.50	0.20
ul	1	2	0.50	0.20
	186		E = 2.47	SD = 0.82

Appendix 4.1: Table 4 : element representation analysis of cattle in Phase 4

	R	I	O	O/E
ast	7	2	3.50	**1.94**
mn	7	2	3.50	**1.94**
pe	6	2	3.00	1.66
ra P	6	2	3.00	1.66
cal	5	2	2.50	1.38
fe P	5	2	2.50	1.38
mc D	5	2	2.50	1.38
tb D	5	2	2.50	1.38
mc P	4	2	2.00	1.11
ra D	4	2	2.00	1.11
hu D	3	2	1.50	0.83
tb P	3	2	1.50	0.83
ul	3	2	1.50	0.83
mph	11	8	1.38	0.76
pph	10	8	1.25	0.69
at	1	1	1.00	0.55
fe D	2	2	1.00	0.55
mt D	2	2	1.00	0.55
sc	2	2	1.00	0.55
dph	5	8	0.63	*0.35*
hu P	1	2	0.50	*0.28*
mt P	1	2	0.50	*0.28*
	98		E = 1.81	SD = 0.52

Appendix 4.1: Table 5: element representation analysis of caprines in Phase 1

	R	**I**	**O**	**O/E**
mc P	7	2	3.50	**1.89**
mn	7	2	3.50	**1.89**
mt D	7	2	3.50	**1.89**
mt P	7	2	3.50	**1.89**
pe	6	2	3.00	**1.62**
ra P	6	2	3.00	**1.62**
mc D	5	2	2.50	1.35
ep	2	1	2.00	1.08
hu D	4	2	2.00	1.08
ra D	4	2	2.00	1.08
ast	3	2	1.50	0.81
cal	3	2	1.50	0.81
fe D	2	2	1.00	0.54
pph	8	8	1.00	0.54
sc	2	2	1.00	0.54
tb D	2	2	1.00	0.54
tb P	2	2	1.00	0.54
ul	2	2	1.00	0.54
mph	5	8	0.63	*0.34*
fe P	1	2	0.50	*0.27*
dph	2	8	0.25	*0.14*
	87		E = 1.85	SD = 0.60

Appendix 4.1: Table 6: element representation analysis of caprines in Phase 2

	R	I	O	O/E
mn	18	2	9.00	3.84
mt P	8	2	4.00	1.70
fe D	7	2	3.50	1.49
mc P	6	2	3.00	1.28
mc D	6	2	3.00	1.28
pe	6	2	3.00	1.28
hu D	6	2	3.00	1.28
sc	5	2	2.50	1.07
ast	4	2	2.00	0.85
cal	4	2	2.00	0.85
mt D	4	2	2.00	0.85
ra D	4	2	2.00	0.85
pph	13	8	1.63	0.69
hu P	3	2	1.50	0.64
fe P	3	2	1.50	0.64
ra P	3	2	1.50	0.64
tb P	3	2	1.50	0.64
ul	3	2	1.50	0.64
ep	1	1	1.00	0.43
mph	8	8	1.00	0.43
tb D	2	2	1.00	0.43
dph	4	8	0.50	*0.21*
	121		E= 2.35	*SD = 0.74*

Appendix 4.1: Table 7: element representation analysis of caprines in Phase 3

	R	I	O	O/E
mn	12	2	6.00	2.72
cal	11	2	5.50	2.49
hu D	11	2	5.50	2.49
ast	8	2	4.00	1.81
ep	4	1	4.00	1.81
pe	8	2	4.00	1.81
tb D	7	2	3.50	1.59
mc D	4	2	2.00	0.91
sc	4	2	2.00	0.91
fe P	3	2	1.50	0.68
fe D	3	2	1.50	0.68
hu P	3	2	1.50	0.68
ul	3	2	1.50	0.68
at	1	1	1.00	0.45
ra P	2	2	1.00	0.45
tb P	2	2	1.00	0.45
pph	5	8	0.63	0.28
mc P	1	2	0.50	0.23
mph	4	8	0.50	0.23
mt P	1	2	0.50	0.23
ra D	1	2	0.50	0.23
dph	3	8	0.38	*0.17*
	101		E = 2.20	SD = 0.84

Appendix 4.1: Table 8: element representation analysis of caprines in Phase 4

	R	I	O	O/E
mn	13	2	6.50	**3.47**
pe	8	2	4.00	**2.13**
tb D	8	2	4.00	**2.13**
hu D	6	2	3.00	1.60
mt D	6	2	3.00	1.60
cal	5	2	2.50	1.33
mc P	5	2	2.50	1.33
mt P	5	2	2.50	1.33
sc	5	2	2.50	1.33
fe D	4	2	2.00	1.07
ast	3	2	1.50	0.80
ra P	3	2	1.50	0.80
at	1	1	1.00	0.53
hu P	2	2	1.00	0.53
tb P	2	2	1.00	0.53
fe P	1	2	0.50	0.27
mc D	1	2	0.50	0.27
ra D	1	2	0.50	0.27
ul	1	2	0.50	0.27
mph	3	8	0.38	0.20
pph	2	8	0.25	*0.13*
dph	1	8	0.13	*0.07*
	86		E = 1.88	SD = 0.84

Appendix 4.1: Table 9: element representation analysis of red deer in Phases 1 and 2 (amalgamated)

	R	**I**	**O**	**O/E**
ast	6	2	3.00	**2.33**
hu D	6	2	3.00	**2.33**
cal	4	2	2.00	1.55
ra D	4	2	2.00	1.55
ra P	4	2	2.00	1.55
tb P	4	2	2.00	1.55
hu P	3	2	1.50	1.17
mc D	3	2	1.50	1.17
tb D	3	2	1.50	1.17
mn	2	2	1.00	0.78
mt D	2	2	1.00	0.78
pe	2	2	1.00	0.78
ul	2	2	1.00	0.78
mph	5	8	0.63	0.49
fe D	1	2	0.50	0.39
fe P	1	2	0.50	0.39
mc P	1	2	0.50	0.39
mt P	1	2	0.50	0.39
pph	3	8	0.38	*0.29*
dph	2	8	0.25	*0.19*
	59		E = 1.29	*SD = 0.65*

Appendix 4.1: Table 10: element representation analysis of red deer in Phase 3

	R	I	O	O/E
tb D	10	2	5.00	2.57
ast	9	2	4.50	2.31
cal	9	2	4.50	2.31
hu D	6	2	3.00	1.54
mc P	6	2	3.00	1.54
ra P	4	2	2.00	1.03
mt P	3	2	1.50	0.77
ra D	3	2	1.50	0.77
sc	3	2	1.50	0.77
ul	3	2	1.50	0.77
dph	10	8	1.25	0.64
mph	9	8	1.13	0.58
pph	9	8	1.13	0.58
mn	2	2	1.00	0.51
mt D	2	2	1.00	0.51
mc D	1	2	0.50	*0.26*
pe	1	2	0.50	*0.26*
tb P	1	2	0.50	*0.26*
	91		E = 1.94	*SD = 0.74*

Appendix 4.1: Table 11: element representation analysis of red deer in Phase 4

	R	I	O	O/E
pe	12	2	6.00	2.57
tb D	10	2	5.00	2.14
tb P	8	2	4.00	1.71
mt P	7	2	3.50	1.50
ast	6	2	3.00	1.28
fe P	5	2	2.50	1.07
mn	5	2	2.50	1.07
mt D	5	2	2.50	1.07
ra D	5	2	2.50	1.07
ra P	5	2	2.50	1.07
sc	5	2	2.50	1.07
fe D	4	2	2.00	0.86
cal	3	2	1.50	0.64
ul	3	2	1.50	0.64
pph	9	8	1.13	0.48
hu P	1	2	0.50	*0.21*
mc P	1	2	0.50	*0.21*
mph	4	8	0.50	*0.21*
dph	2	8	0.25	*0.11*
	100		E = 2.34	*SD = 0.66*

Appendix 5.1

Appendix 4.1 provides the tables that Figures 5.4 and 5.5 are based on. Calculations follow O'Connor (2000, 72 – 73). Column R is the minimum number of the skeletal part retrieved, while "I" represents the number of each skeletal part in the individual animal. Dividing R by I provides the "observed" figure "O". The arithmetic mean is then calculated to give the expected figure (E) if the specimens in the sample were evenly distributed across all elements. The observed figure divided by the expected figure gives the ratio O/E. The ratio indicates how much more or less abundant each skeletal part is than the mean. Calculation of the standard deviation of the O/E figures identifies which elements lie one standard deviation above the mean (in bold type) or below it (in italics; O'Connor 2000, 73).

Appendix 5.1: Table 1: Element representation analysis of cattle

element	R	I	O	O/E
ast	39	2	19.50	2.41
cal	36	2	18.00	2.22
mc P	25	2	12.50	1.54
sc	23	2	11.50	1.42
mn	21	2	10.50	1.30
ra P	21	2	10.50	1.30
hu D	19	2	9.50	1.17
pe	19	2	9.50	1.17
mt P	18	2	9.00	1.11
tb D	18	2	9.00	1.11
mc D	16	2	8.00	0.99
mt D	15	2	7.50	0.93
mph	57	8	7.13	0.88
pph	57	8	7.13	0.88
ra D	13	2	*6.50*	*0.80*
fe P	10	2	5.00	0.62
tb P	10	2	5.00	0.62
fe D	9	2	4.50	0.56
dph	31	8	3.88	0.48
hu P	4	2	2.00	*0.25*
at	1	1	1.00	*0.12*
ep	1	1	1.00	*0.12*
total	**463**		**178.13**	**SD = 0.58**
		E =	8.10	

Key:
E – expected figure (if elements distributed equally)
SD – standard deviation
R – minimum number of skeletal part retrieved
I – number of that skeletal part in an individual animal
O – R/I – the "observed" number of each skeletal part
(For key to element abbreviations see Figure 5.4).

Appendix 5.1: Table 2: element representation analysis of caprines

	R	*I*	*O*	*O/E*
ast	16	2	8.00	**2.12**
hu D	14	2	7.00	**1.85**
mn	14	2	7.00	**1.85**
tb D	14	2	7.00	**1.85**
mc P	13	2	6.50	**1.72**
mc D	13	2	6.50	**1.72**
sc	12	2	6.00	1.59
fe P	8	2	4.00	1.06
cal	7	2	3.50	0.93
fe D	7	2	3.50	0.93
mt P	7	2	3.50	0.93
pe	7	2	3.50	0.93
ra D	7	2	3.50	0.93
ra P	6	2	3.00	0.79
mt D	5	2	2.50	0.66
pph	19	8	2.38	0.63
hu P	3	2	1.50	0.40
tb P	3	2	1.50	0.40
ep	1	1	1.00	*0.26*
ul	2	2	1.00	*0.26*
mph	5	8	0.63	*0.17*
dph	1	8	0.13	*0.03*
	184		E = 3.78	0.64

Appendix 5.1: Table 3: element representation analysis of red deer

	R	I	O	O/E
sc	56	2	28.00	**3.57**
ast	53	2	26.50	**3.38**
hu D	45	2	22.50	**2.87**
ra P	28	2	14.00	1.79
tb D	27	2	13.50	1.72
tb P	22	2	11.00	1.40
ra D	21	2	10.50	1.34
fe D	17	2	8.50	1.08
ul	15	2	7.50	0.96
fe P	12	2	6.00	0.77
pe	12	2	6.00	0.77
hu P	8	2	4.00	0.51
mc D	7	2	3.50	0.45
mt D	6	2	3.00	0.38
dph	18	8	2.25	0.29
mt P	4	2	2.00	0.26
ep	1	1	1.00	0.13
pph	7	8	0.88	0.11
mph	6	8	0.75	0.10
mc P	1	2	0.50	0.06
mn	1	2	0.50	0.06
	367		E = 7.84	SD = 1.08